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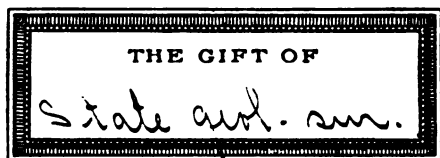
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IOWA GEOLOGICAL SURVEY

Supplementary Report

1903

THE
GRASSES OF IOWA

PART II *of Bulletin No. 1*

FRANK A. WILDER, PH. D., STATE GEOLOGIST

T. E. SAVAGE, ASSISTANT STATE GEOLOGIST

DES MOINES, IOWA

1904

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THE Iowa Geological Survey takes pleasure in presenting to the state as a Supplementary Report, Part II of The Grasses of Iowa. The hearty reception given the volume already in the hands of the public has fully borne out the prophecy that its subject-matter would appeal to all who are interested in developing the agricultural interests of the state. The vast amount of work represented by this volume, as well as by volume 1, was done absolutely without cost to the state. Many of the plates used in illustrating the species of grasses were also generously furnished by the writer of this report without expense to the state.

FRANK A. WILDER,
State Geologist.

The Descriptive and Geographical Study
of the Grasses of Iowa

BY

L. H. PAMMEL
CARLETON R. BALL
AND F. LAMSON-SCRIBNER

PREFACE

Several years have elapsed since Part I, Bulletin I, of the "Grasses of Iowa" was published. Part I, naturally, covered the general, biological, chemical and feeding problems connected with the grasses of the state. When that work was being prepared it was thought possible to bring all this material together into one volume. As the work progressed, however, it seemed desirable to present the matter in two parts: Part I dealing with the general biology, and Part II with the descriptive and geographical study of the grasses of Iowa. After many delays the work of printing Part II was begun early in January.

I am greatly indebted to Miss Charlotte M. King for many of the drawings prepared expressly for this work by her; also for her help in connection with synonymy. To Mr. R. E. Buchanan and Miss Estelle D. Fogel I am indebted for careful proof-reading and other assistance. Mr. Buchanan and Miss Fogel prepared the index, which is unusually complete. For clerical assistance I am indebted to Miss Mae Combs, Miss Jennie Wharton and Miss Helen Dickerson. To Mr. T. E. Savage I am greatly indebted for his unfailing kindness in looking after the many details of arrangement of subject-matter. I wish, also, to express my thanks to the many friends who have assisted by their contributions of grass material from all parts of the state for use in determining distribution.

The descriptions for the most part are furnished by the staff in the Division of Agrostology of the U. S. Department of Agriculture: E. D. Merrill, C. R. Ball, F. Lamson-Scribner, C. L. Shear, J. Smith and T. H. Kearney. Mr. Carleton R. Ball is responsible for the diagnostic keys. Professor Spillman, of the Bureau of Plant Industry, gave his consent to this use of descriptions furnished by the Division of Agrostology.

L. H. PAMMEL.

Ames, Iowa, Jan. 15, 1905.

Issued April 1, 1905.

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CHAPTER I.

Gramineæ (Grasses).

GENERAL DESCRIPTION.

Fibrous-rooted annual or perennial, herbaceous (rarely woody) plants, with usually hollow, cylindrical (rarely flattened), and jointed stems (*culms*) whose internodes for more or less of their length are enveloped by the sheath-like basal portion of the two-ranked and usually linear, parallel-veined leaves; flowers without any distinct perianth, hermaphrodite or rarely unisexual, solitary or several together, in *spikelets*, which are arranged in panicles, racemes, or spikes, and which consist of a shortened axis (the *rachilla*) and two or more chaff-like, distichous, imbricated bracts (*glumes*), of which the first two, rarely one or none or more than two, are empty (*empty glumes*); in the axil of each of the succeeding bracts (excepting sometimes the uppermost) is borne a flower (hence these are named *flowering glumes*). Opposed to each flowering glume, with its back turned toward the rachilla, is (usually) a two-nerved, two-keeled bract or prophyllum (the *palea*), which frequently envelops the flower by its infolded edges. At the base of the flower, between it and its glume, are usually two very small hyaline scales (*lodicules*); rarely there is a third lodicule between the flower and the palea; stamens, usually three (rarely two or one, or more than three) with very slender filaments and two-celled, usually versatile anthers; pistil with a one-celled, one-ovuled ovary, and one to three, usually two styles with branched, most frequently plumose, stigmas; embryo small, lying at the front and base of the seed, covered only by the thin pericarp; fruit a caryopsis, rich in albumen. (In *Sporobolus* and *Eleusine* the thin pericarp is free from the seed.)

There are about 3500 species of grasses. The number given by Benthams & Hooker¹ is from 3100 to 3200, but Hackel² gives the number about 3500, the latter number probably being more nearly correct, considering that new territory is being explored, and new species are

¹ Gen. Pl. 8: 1074.

² Nat. Pflanz. Fam. II. 2: 16.

constantly being added. It is probable that the number will reach nearly 3700. Heller¹ gives 1234, while Patterson² lists 868 species for North America. These figures of Patterson were undoubtedly based upon reports by Doctors Gray, Watson and others connected with the Harvard Herbarium at the time the work of Patterson was prepared. Probably more species have been added than there should be. A careful study will no doubt show that some of the so-called species may be reduced to synonyms later. Sir Joseph D. Hooker³ gives 103 species.

Of the genera, Bentham & Hooker⁴ recognize 298, Hackel⁵ recognizes 313, Heller recognizes 131; Patterson in his "Check list" recognizes 115, Lamson-Scribner⁶, 137.

The grasses vary in size from the moss-like *Coleanthus* of the north to the tree-like bamboos of the tropics, many of which are more than 100 feet high. The grasses occur from the Kerguelen land of the south to the extreme limit of vegetation beyond the Arctic Circle. There is no order of plants more widely distributed, or existing under a greater diversity of soil and climate, and no other order presents such a vast number of individual plants or is so important and directly useful to man.

The characters employed in defining the tribes and genera are usually those presented in the spikelets or inflorescence. While the characters of the order are well defined and clearly separate it from all other families of plants, the establishment of the several subdivisions is very difficult, and in no case can be based upon a single character alone, but upon a combination of them. There is no tribe or large genus which can be separated or defined absolutely from all others; there are always exceptions or intermediate forms connecting them.

SERIES A.—PANICACEÆ.

Spikelets one, rarely two-flowered; when two-flowered the second or terminal one is perfect, the first or lower one being either staminate or neuter; rachilla articulated below the empty glumes, the spikelets falling from the pedicels, either single, or in groups, or together with the joints of an articulate rachis. The first six tribes belong to this series.

The first grand division of the order Gramineae is based upon two characters in combination, the articulation of the pedicels just below

¹ Cat. N. Am. Plants North of Mexico, exclusive of the lower cryptogams.

² Check list of North American Plants. 137.

³ The Student's Flora of the British Islands. 449.

⁴ *Id.* 1074-1215.

⁵ *Id.* 1-97.

⁶ American Grasses. Bull. U. S. Dept. Agr. Div. Agros. 20.

the spikelets or cluster of spikelets and the single perfect flower, which may or may not have a staminate or imperfect flower below it. There are never more than four glumes in the spikelets, the first three being empty or the third with a rudimentary or staminate flower in its axil; the fourth glume subtends the perfect or hermaphrodite flower. In a few genera the spikelets are reduced to two or even only one glume, but in these cases the articulation of the spikelet with the pedicel below the outer glume indicates its connection with this series.

KEY TO THE TRIBES IN SERIES A.—PANICACEÆ.

1. Spikelets usually much compressed laterally, 1-flowered; empty glumes none or rudimentary; flowers staminate, pistillate, or hermaphrodite.

—TRIBE VI. ORYZEÆ.

2. Spikelets either staminate or pistillate, each in a separate inflorescence on the same plant, or in distinct parts of the same inflorescence.

—TRIBE I. MAYDEÆ.

3. Spikelets either all hermaphrodite or hermaphrodite and staminate, regularly arranged and usually in pairs, one sessile, the other pedicellate in the same inflorescence (both pedicellate in *Trachypogon*).

—TRIBE II. ANDROPOGONEÆ.

4. Spikelets in groups of two to six at each joint of the main axis, each group falling off entire; flowering glumes usually awnless. (*Cathestechum* may be looked for here.).....

TRIBE III. OSTERDAMIEÆ.

5. Flowering glumes of the perfect flowers membranaceous and (in American species) awned.....

TRIBE IV. TRISTEGINEÆ.

6. Flowering glumes of the perfect flower cartilaginous, coriaceous or chartaceous and awnless or (in *Eriochloa*) with a short, straight awn.

—TRIBE V. PANICEÆ.

SERIES B.—POACEÆ.

Spikelets one to many-flowered, the imperfect or rudimentary flower, if any, usually uppermost; rachilla usually articulated above the empty glumes, so that these remain after the fall of the fruiting glumes.¹ In spikelets with two or more flowers these are separated by a manifest internode of the rachilla, and in such cases the rachilla is usually articulated below each flowering glume.

In this second grand division of the Gramineæ the pedicels are not (or are very rarely) articulated below the outer glumes, but the axis of the spikelet is articulated above these glumes, so that they usually remain attached to the pedicel after the falling off of the mature florets. The spikelets are one to many-flowered, and have as many flowering glumes as there are flowers; the imperfect flowers, when present, are the uppermost; the terminal floret may be staminate or rudimentary.

¹ In *Alopecurus*, *Cinna*, *Spartina*, *Beckmannia* and *Holcus* the rachilla is articulated below the empty or outer glumes, and the spikelets fall off entire.

KEY TO THE TRIBES IN SERIES B.—POACEAE.

1. Spikelets 1-flowered, with or without a simple continuation of the rachilla behind the palea.....2
1. Spikelets 2-many-flowered.....5
2. Spikelets crowded in two (rarely one) rows along one side of a continuous rachis forming unilateral spikes, these scattered along a common axis or digitate at the apex of the stem.....TRIBE X. CHLORIDEAE.
2. Spikelets not disposed in unilateral spikes.....3
3. Inflorescence spicate, the spikelets sessile on alternate teeth or notches of the rachis.....TRIBE XII. HORDEAE.
3. Inflorescence racemose (not unilateral) or paniculate, occasionally contracted and spike-like, or condensed and apparently capitate; spikelets always distinctly pedicellate.....4
4. Glumes five, the first four empty or (in *Hierochloa*) the third and sometimes the fourth, which are usually very unlike the first and second, with staminate flowers; the fifth glume with a hermaphrodite flower, and falling with the third and fourth; palea 1-nerved.....TRIBE VII. PHALARIDEAE.
4. Glumes three (only one in *Coleanthus*, or occasionally four in some species of *Sporobolus* and *Muhlenbergia*), the first two empty; palea 2-nerved or nerveless, very rarely 1-nerved (*Cinna*) or wholly wanting (*Alopecurus* and some species of *Agrostis*).....TRIBE VIII. AGROSTIDEAE.
5. Culms herbaceous, annual; leaf blade continuous with the sheath.....6
5. Culms woody, perennial; leaf blade articulated with the sheath.
—TRIBE XIII. BAMBUSEAE.
6. Spikelets pedicellate, in panicles, spike-like panicles, or racemes, these never unilateral.....7
6. Spikelets sessile, in true spikes, or on very short pedicels in unilateral racemes.....8
7. Empty glumes generally longer than the first flowering glume; one or more of the flowering glumes awned on the back or from between the teeth of the bifid apex (some cultivated forms excepted); awn twisted, usually geniculate, very rarely straight.....TRIBE IX. AVENEAE.
7. Empty glumes generally shorter than the floral glume; flowering glume awnless or with from one to many terminal (very rarely dorsal) straight or simply divergent awns.....TRIBE XI. FESTUCEAE.
8. Spikelets in unilateral spikes or racemes, these racemes, digitate or fasciculate.....TRIBE X. CHLORIDEAE.
8. Spikelets inserted on the alternate teeth or notches of the rachis forming equilateral, flattened, or cylindrical terminal spikes....TRIBE XII. HORDEAE.

Different recent authors have adopted slight modifications in the classification of grasses.

HACKEL'S KEY TO THE TRIBES.

A. Spikelets one, rarely two-flowered, lower flowers when present imperfect; falling from the pedicel entire or together with certain joints of the rachis at maturity. Rachilla not produced beyond the flowers. Internodes between the different glumes or flowers not measureable.

a. Hilum punctiform. Spikelets not flattened laterally, but usually somewhat dorsally compressed or else perfectly round.

I. Flowering glumes and palea (the latter often wanting) hyaline. Empty glumes thick membranaceous to coriaceous or cartilaginous, the lowest the largest with its edges embracing the others. Spikelets generally in racemes or spikes whose articulate axes break up at maturity.

1. Staminate and pistillate spikelets in separate inflorescences or on different parts of the same inflorescence.....I. MAYDEAE.

2. Spikelets either all perfect, or staminate and perfect, and so arranged in the same inflorescence that a staminate stands near a perfect.....II. ANDROPOGONEAE.

II. Flowering glumes and palea membranaceous; empty glumes, herbaceous, chartaceous or coriaceous, the first generally the largest; spikelets falling off singly or in groups from the continuous rachis.

—III. ZOYSIEAE.

III. Flowering glume and palea membranaceous, empty glumes, herbaceous or chartaceous; the first empty glume smaller or narrower than the following ones. Spikelets falling off singly from the ultimate branches of the panicle.....IV. TRISTEGINEAE.

IV. Flowering glume and palea cartilaginous, coriaceous or chartaceous. Empty glume more delicate, usually herbaceous, the first usually smaller. Spikelets falling off singly from the ultimate branches of the panicle or continuous (rarely articulate) rachis of a spike.

—V. PANICEAE.

b. Hilum linear, spikelets laterally compressed.....VI. ORYZEAE.

B. Spikelets 1-many-flowered, the 1-flowered frequently with the rachilla produced beyond the flowers, rachilla generally articulated above the empty glumes, so that these remain after the fall of the fruiting glumes. When from two to many-flowered there always are distinct internodes between the flowers.

a. Culm herbaceous, annual; leaf-blade sessile, not articulated with the sheath.

Spikelets upon distinct (sometimes very short) pedicels, in panicles, spike-like panicles, or racemes (without notches in the main axes).

I. Spikelets one-flowered:

1. Empty glumes four, palea one-nerved.

—VII. PHALARIDEAE.

2. Empty glumes two (rarely none), palea two-nerved.

—VIII. AGROSTIDEAE.

II. Spikelets 2-many-flowered:

1. Flowering glume generally shorter than the empty ones; usually with a bent awn on the back, rarely awned from the point or awnless. When not awned there are two nearly opposite florets, and the rachilla is not produced beyond them.....IX. AVENEAE.

2. Floral glume generally longer than the empty ones, unawned or with a straight awn from the point (seldom below).

—XI. FESTUCEAE

Spikelets crowded in two close rows, forming a one-sided spike or raceme with a continuous axis.....X. CHLORIDEAE...

Spikelets in two (rarely more) opposite rows forming an equilateral spike (very rarely unilateral).....XII. HORDEAE.

b. Culm (at least at the base) woody, leaf-blade often with a short slender petiole articulated with the sheath from which it finally separates.

—XIII. BAMBUSEAE.

TRIBE 1.—MAYDEÆ.

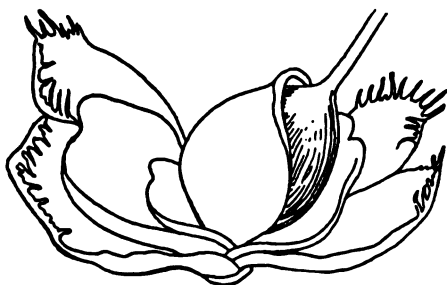


FIG. 1. Fertile flower—Maize (*Zea Mays*),
(Charlotte M. King.)

Spikelets unisexual, the staminate forming a part of the inflorescence with the pistillate, or each in a separate inflorescence on the same plant; flowering glumes hyaline or much less firm in texture than the outer ones; axis of the female spikelet usually articulated.

The tribe Maydeae contains sixteen species distributed in seven genera, and is remarkable for a number of monotypic types. They are native to the tropics. The best known illustrations are maize and *Euchlaena*.

KEY TO THE GENERA OF THE MAYDEÆ.

A. Staminate and pistillate spikelets in separate inflorescences, the staminate above.

Staminate spikes numerous in terminal panicles. Pistillate spikes many-flowered, axillary, subtended by large, leaf-like bracts.

Pistillate spikes in each axil fasciculate, distinct, rachis of each articulatedEUCHLAENA. 1.

Pistillate spikes in each axil united, forming a compound spike with much thickened continuous axis.....ZEA. 2.

Staminate spikes solitary, pistillate spikes usually reduced to a single spikelet, enclosed by an indurated sheath.....COIX. 3.

B. Staminate and pistillate spikelets in the same spike the staminate above.

—TRIPSACUM. 4.

1. EUCHLAENA.

Euchlaena Schrad. Ind. Sem. Hort. Goett. 1832 Benth. and Hook. Gen. Pl. 3: 1114. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 19. Scribner. Bull. U. S. Dept. Agri. Div. Agros. 20: 11. f1.

DESCRIPTION.

TEOSINTE. Spikelets unisexual, monoecious; the staminate two-flowered in pairs, one sessile, the other pedicellate, along the numerous paniculate racemes; the pistillate 1-flowered, sessile and solitary at each



FIG. 2. Teosinte (*Euchlana Mexicana*). *a* and *b*, ears enclosed by husk; *c* and *d*, views of grain. A valuable forage grass. (U. S. Dept. Agr.)

joint of an obliquely articulate rachis of a simple spike; the spikes fasciculate in the leaf axils and each more or less enveloped in a foliaceous bract. Glumes of the staminate spikelets 4, acute, the first two membranaceous, empty; flowering glumes smaller and like their paleas, hyaline, stamens 3. Glumes of the pistillate spikelets 4, the outer one broad and boat-shaped, smooth, soon becoming very hard, surrounding the inner glumes and narrow rachis, second glume coriaceous, third glume hyaline with a palea but no flower; fourth or flowering glume and its palea hyaline. Styles very long, filiform, shortly bifid at the apex.

Tall annuals with long and broad leaves, closely resembling Indian corn in habit. Species 1 with several varieties in Mexico and Central America. Frequently cultivated in the southern states, and occasionally in Iowa for soiling purposes.

2 ZEA.

Zea. L. Sp. Pl. 971. 1753. Endlicher. Gen. Pl. 80. Hackel in Engler and Prantl. Nat. Pflanz Fam II. 2: 19. Benth. & Hook Gen. Pl. 3: 11.4. Scribner, Bull. U. S. Dept. Agr. Div. Agros. 20:12. f. 2.

DESCRIPTION.

MAIZE. Spikelets unisexual, monoecious; the staminate two-flowered, in pairs, one sessile, the other pedicellate, arranged in terminal branches of a terminal panicle; the pistillate one-flowered, sessile, crowded in several rows, along the much thickened continuous axis arising from the lower leaf-axil and closely enveloped by numerous large foliaceous bracts. Glumes 4, awnless; those of the staminate spikelet acute; those of the pistillate very broad and obtuse or emarginate. Grain hard, only partially enclosed by the fruiting glumes. A well-known tall and striking annual grass with erect stems and broad leaves. The terminal staminate inflorescence forms the "spindle" and the long projecting styles of the pistillate flowers constitute the "silk." The cob is formed by the union of the axes of several female spikes into a much thickened body.

Dr. E. L. Sturtevant,¹ who more than any one else has studied maize in our country, regards the genus as monotypic and only recognizes the *Zea mays*.

Species 1 or 2, of American origin, presenting many varieties in cultivation known as corn, Indian corn or maize.

¹ See Bull. 1. Ia. Geol. Survey, p. 443.

¹ Bull. U. S. Dept. Agr. of Exp. Sta. 57: 7.



FIG. 3. Different types of maize. *a*, Yellow dent; *b*, yellow flint; *c*, sweet corn; *d*, pop-corn.
(Photograph by Charlotte M. Kling.)

The *Zea canina* of Watson¹ according to Sturtevant, is most closely allied to the pop-corn. Doctor Sturtevant has arranged cultivated corn into the following groups:

The pod-corn, *Zea tunicata*. Stur. Torr. Club. 1894: 335.

The pop-corn, *Zea everta*. Stur. Bull. Torr. Bot. Club. 1894: 324.

The flint-corn, *Zea indurata*. Stur. Bull. Torr. Bot. Club. 1894: 327.

The dent corn, *Zea indentata*. Stur. Bull. Torr. Bot. Club. 1894: 329.

¹ Proc. Am. Acad. Arts & Sci. 26: 158. Contr. Am. Bot. 18: 158.

Soft corn, *Zea amylacea*. Stur. Bull. Torr. Bot. Club. 1894: 331.

Sweet corn, *Zea saccharata*. Stur. Bull. Torr. Bot. Club. 1894: 333.

Zea amyleasaccharata, Stur. Rep. Geneva, N. Y. Agrl. Exp. 1886: 66.

The so-called species and groups of Doctor Sturtevant are hardly to be regarded as varieties. Some of the forms under conditions of culture and climate, revert to their original type. They are certainly not

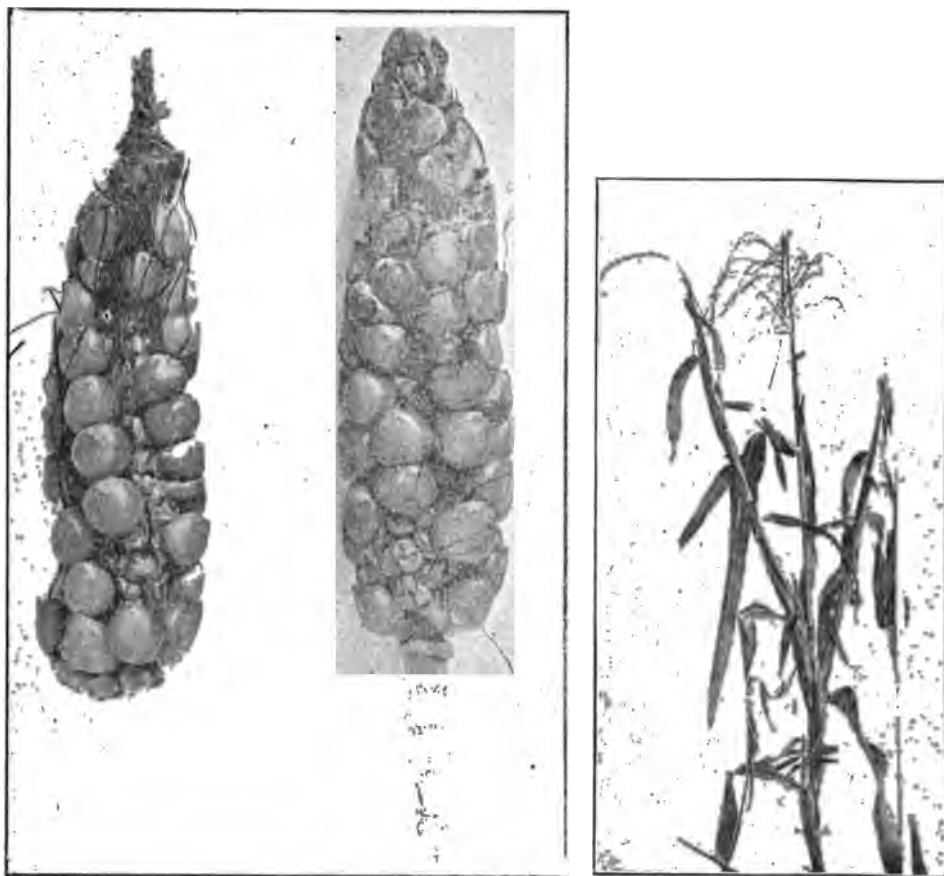


FIG. 4. a and b, *Zea canina*, grown at Knoxville, Tenn. (U. S. Dept. Agrl.)

to be regarded as varieties. A plant cultivated for so long a time by the Indians and civilized man has naturally given rise to diverse forms. We regard them as nothing more than races of the very polymorphic species *Zea mays*.

ZEA CANINA.

Zea canina Watson. Proc. Am. Acad. Arts & Sci. 26: 160.

DESCRIPTION.

Culms variable in height, 6-10 feet (18-30 dm.), several from the same root; ascending branched, staminate racemes short or elongated and drooping; spikelets 2-4 but usually 3 at each node. One or more with short pedicels; empty glume 3-5 nerved, keeled (bicarnate), pistillate spikes, sessile in the axis and terminal; ears small, 4-12 rowed, separating more or less readily at the joints; kernels small, 3-4 lines long, white, hard, smooth, ovate, acute, constricted at the base. Sent to Doctor Watson by Professor Duges from Moro Leon about four Mexican leagues from Lake Cuitzo. The natives consider this *mais de coyte* to be the source of the cultivated varieties of *maize*. I will append an interesting account of this given by Doctor Watson.

"Prof. W. H. Brewer, in a communication to Doctor Sturtevant, to be found in the paper of the latter upon "Indian Corn" in the Report of the New York State Agricultural Society for 1878 gives a statement which Roezl, the well known German collector, made to him in 1869 to this effect: that "he found in the State of Guero a *Zea* which he thinks specifically distinct, and he thinks undescribed; the ears very small, in two rows truly distichous; the ear (but not each grain separately) covered with a husk, the grain precisely like some varieties of *maize*, only smaller and harder."

"Specimens of *Zea* which are in all probability the same that Roezl referred to, were received by me in 1888 from Prof. A. Duges of Guanajuato under the designation of *mais de coyte*. It was reported to him as growing wild in Moro Leon, to the south of the State of Guanajuato, and as not at all resembling ordinary varieties of *maize*. The specimens sent were two very slender stalks about four feet high, with a very small terminal staminate inflorescence but no trace of fertile spikes. These were probably very depauperate stalks, that had been selected for easy carriage. Accompanying them was a united cluster of about half a dozen small ears enveloped in their husks, each about two inches long and bearing a few rows of small white pointed kernels.

"Some of the peculiarities of this remarkable corn were noted at the time, but nothing more was done until last year, when an attempt was made to grow it at the Botanic Garden, Cambridge, with quite unexpected results. The corn was planted early under glass, and as soon as danger from frosts was over the plants were transferred to a warm, sunny location, where they soon began to grow vigorously and to send out numerous offshoots from the base. These "suckers" grew as rapidly as the main stock, so that the plants, which had fortunately been placed some feet apart, had the appearance of "hills" one of the two having nine and the other twelve stalks ascending from a common base.

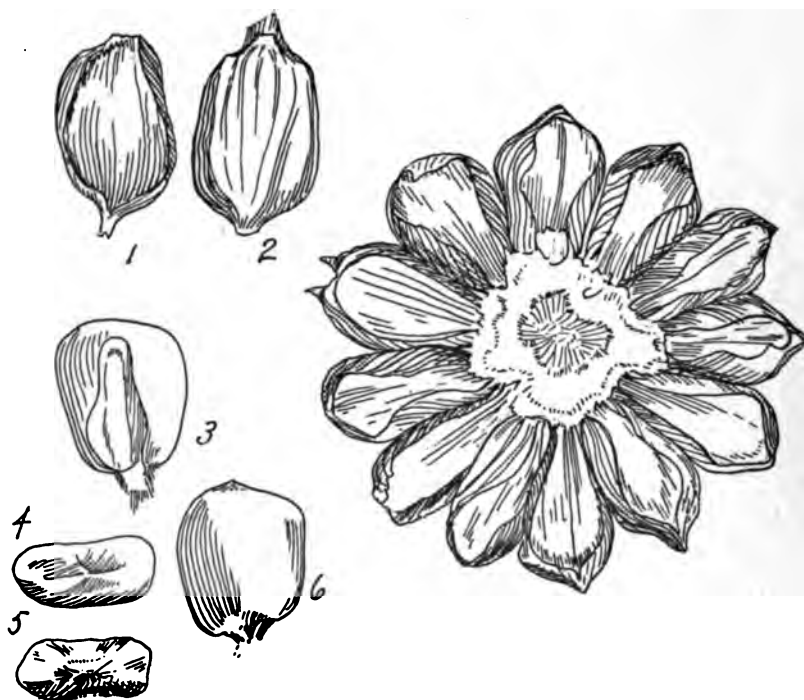


FIG. 5. Primitive corn. 1-6, different views of kernel. Upper figure from photograph.
(Charlotte M. King.)

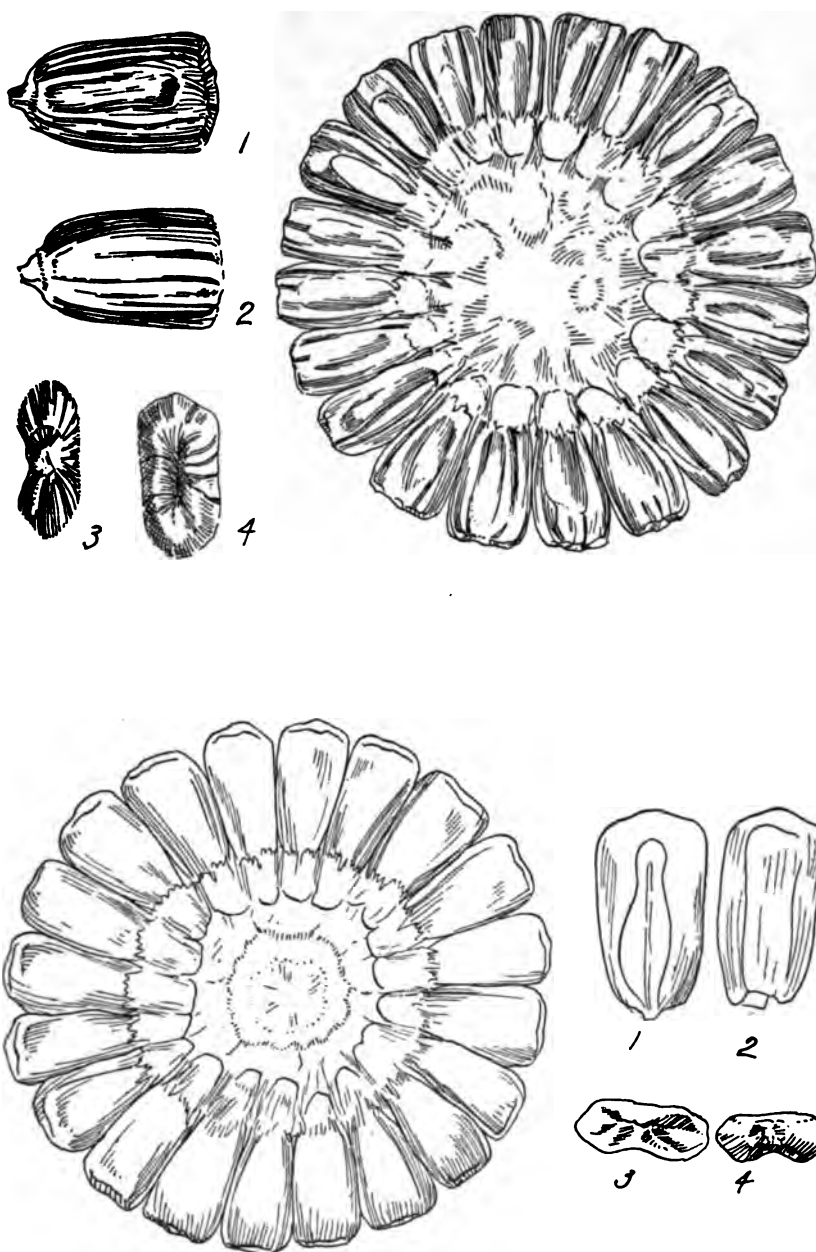


FIG. 6. Above, Calico dent; 1-4 different views of kernel; below, Legal Tender Yellow dent; 1-4 different views of kernel. (Charlotte M. King.)

The tallest were over ten feet high, with a diameter of nearly two inches, and they would have become yet taller had the season permitted. Their foliage and pubescence were in every way as in ordinary field corn, the staminate tassels with conspicuously longer and more drooping racemes, the habit of growth wholly unusual. In our ordinary form the erect culm is always apparently single, bearing solitary axillary ears which terminate a usually short leafy-bracted peduncle. This peduncle is in fact a lateral branch, bearing a terminal pistillate spike corresponding to the staminate panicle on the main stem. In this Mexican corn, on the other hand, the better developed stalks were evidently branched from several of the axils, the branches often becoming three or four feet in length, very leafy, and having at least a rudimentary ear in the axil of every leaf. Several, sometimes half a dozen, perfect ears were formed upon each branch. The terminal ear was always androgynous, staminate at the summit. On the shorter stems the branches were reduced to a more or less crowded axillary cluster of ears similar to the one received from Professor Duges. The last year's season was a long one, and there was no heavy frost in Cambridge until near the end of October. The corn, however, was at that time still very green, and the stalks were finally cut and stored under shelter in the hope that the ears would ripen in the stack; but upon very few did any of the kernels mature.

"The natural supposition was that we had here at least the original wild state of our cultivated maize. A careful comparison of the two, as thorough as the material at hand of the cultivated forms would permit, has led me first to doubt the probability of this, and now to consider the form in question a distinct species. The differences upon which this conclusion is based are in the habit of growth, the arrangement of the staminate spikelets, and the nervation of their glumes, the form of the glumes of the pistillate flowers, and the ready disarticulation of the ripened ear.

'It appears from descriptions, figures, and such specimens as I have seen of cultivated maize, that the staminate spikelets are in pairs at the joints of the rachis, and their empty glumes 7-9 nerved. In the Mexican plant there are usually three and sometimes four together, one of them short-pedicelled, the others more nearly sessile. The empty glumes are 3-5 nerved and bicarinate, the flowering ones more narrow than in *Zea Mays*. The pistillate spikelets are in pairs at the joints of the rachis, the internodes of which are more or less strongly margined and cupulate, and finally become hard and shining. The glumes are very broad, strongly concave and enfold each other much more than in the flowers, of *Zea Mays* that I have examined, and more than they are rep-

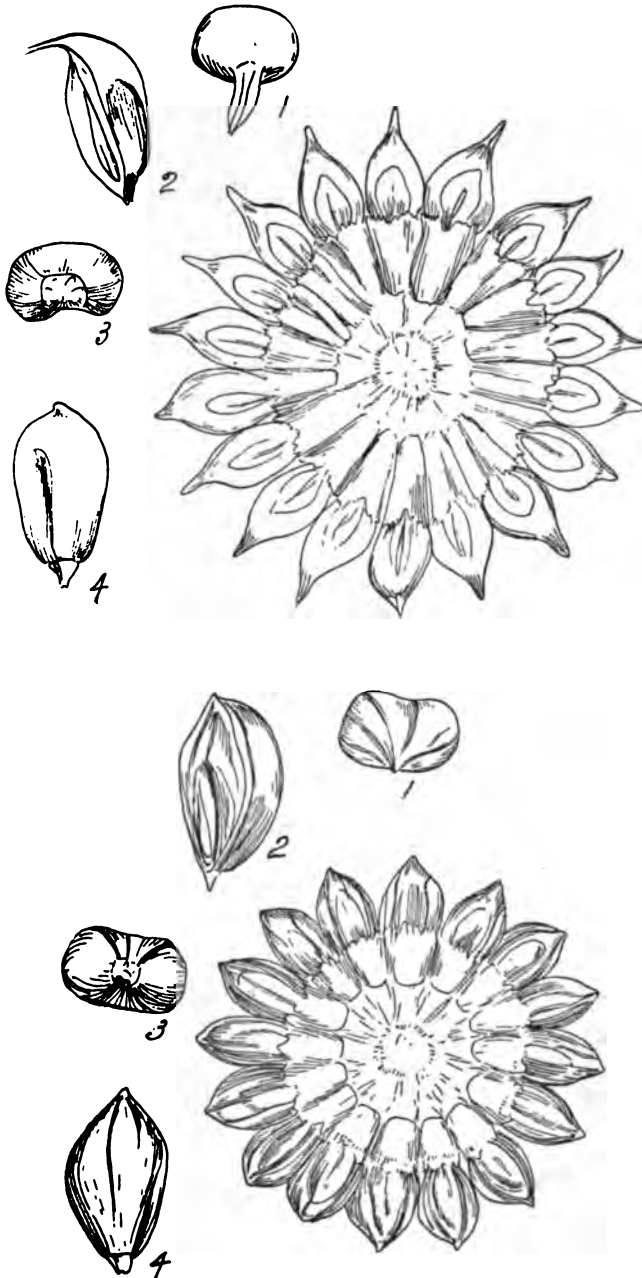


FIG. 7. Above, striped Rice pop-corn; 1-4, views of kernels; below, White Rice corn; 1-4, views of kernels. (Charlotte M. King.)

resented in the figures of Nees and Doell. The lower glume becomes very hard and rigid, excepting its margins and firmly embraces the lower part of the kernel.

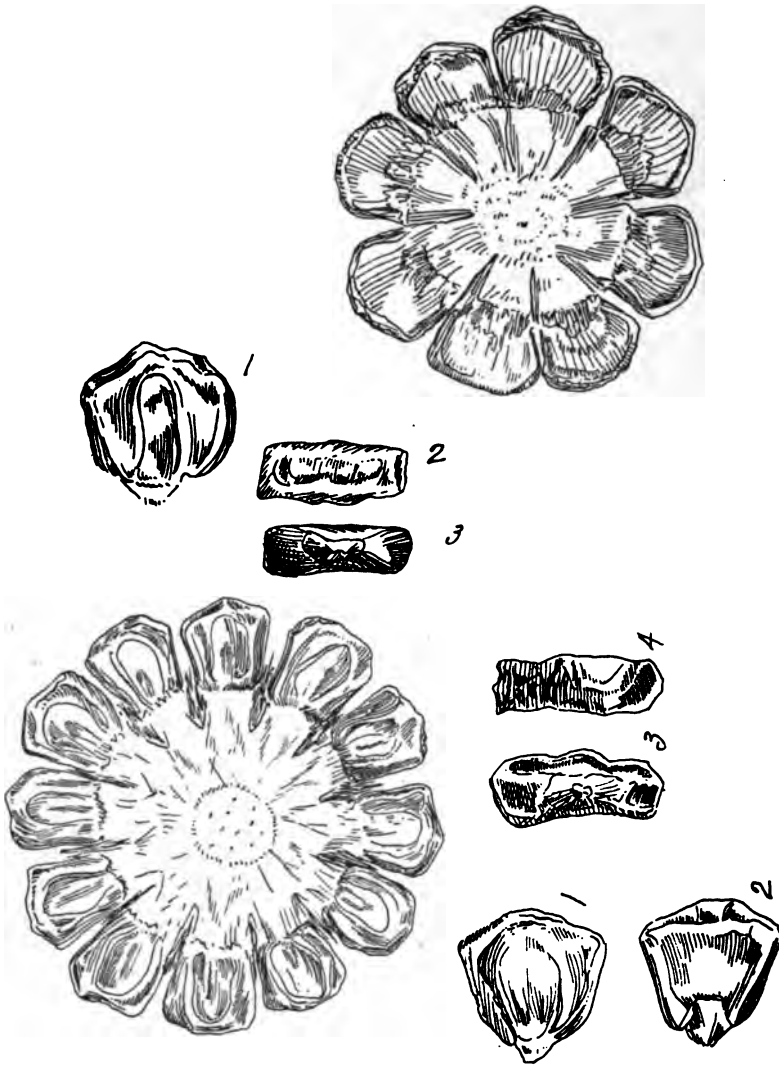


FIG. 8. Above, Red Cob Sweet corn; 1-3, views of kernel; below, Hybrid Sweet corn; 1-4, views of kernel. (Charlotte M. King.)

"The ears upon the plants raised in the Botanic Gardens were very variable, from scarcely two inches to four inches in length and three-fourths of an inch broad, tapering slightly to an acutish apex, and with

the kernels in four, eight, ten and sometimes twelve, but most frequently in ten rows. A comparison of these shows clearly the structure of the ear. When there are only four rows, the ear is flattened and distichous, and the opposite pairs of rows are evidently the result of the pairs of spikelets regularly alternating upon the opposite sides of an extremely short - jointed and flexuous rachis. In the eight-rowed ear the rachis is four-sided instead of two-sided, and in the ten-rowed it becomes five-sided. This latter case corresponds to the arrangement in the terminal raceme of the staminate inflorescence, where the spikelets are usually in five ranks. In the eight-rowed ear each joint bears two opposite pairs of spikelets, alternating with those of the joints immediately above and below, and in the twelve-rowed there are three pairs to each joint,

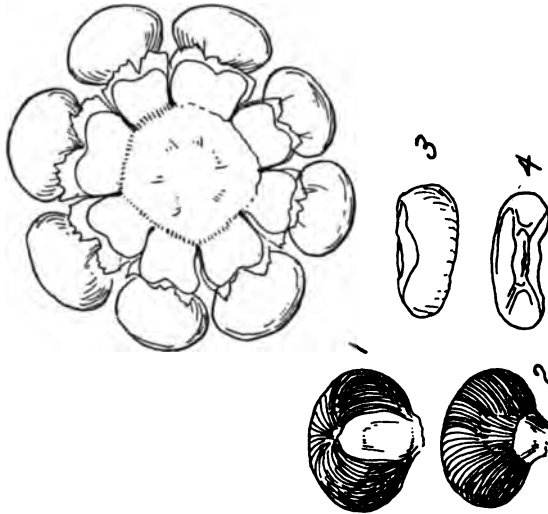


FIG. 9. Yellow Flint Corn. (Charlotte. M. King.)

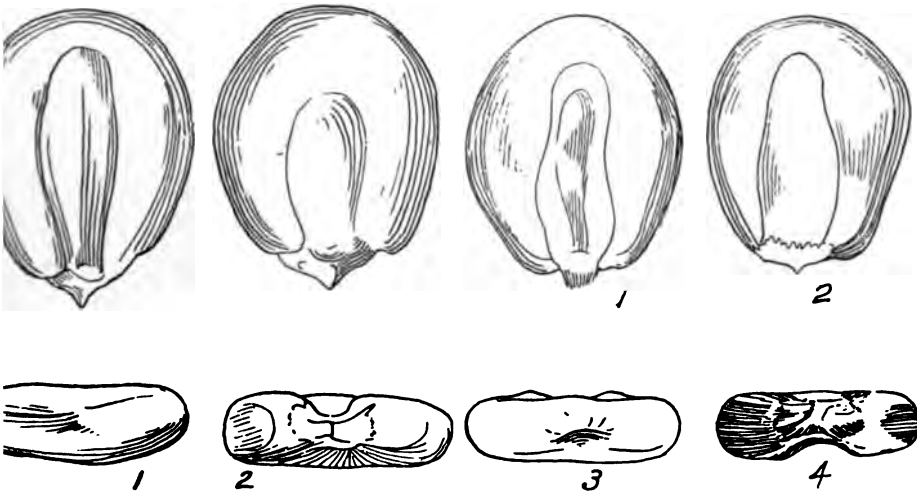


FIG. 10. Left, Yellow Cuscuta corn; right, Brown Cuscuta corn. (Charlotte M. King.)

alternating in the same way. The kernels are somewhat imbricated in the rows, and usually alternating, owing to one of the spikelets in each pair being slightly pedicellate. They are small, ovate, somewhat flat-

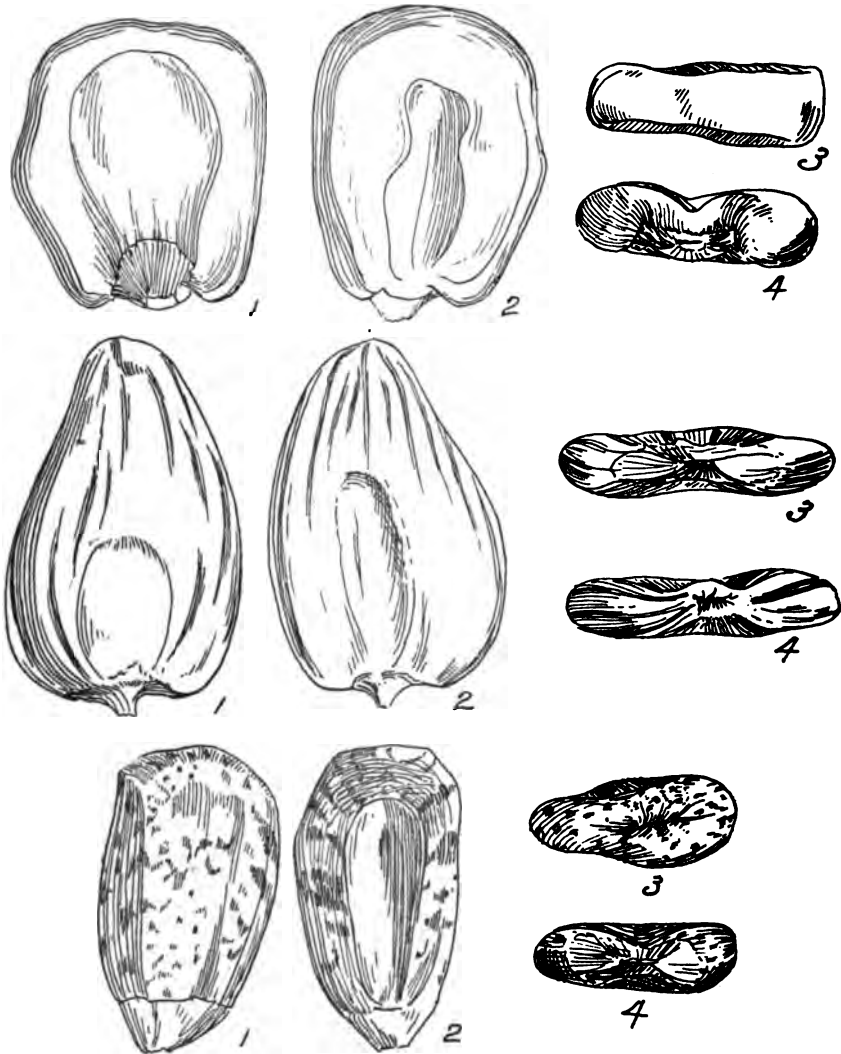


FIG. 11. *a*, Red Ouszeo corn; 1-4, views of kernels; *b*, Calico Ouszeo corn; 1-4, views of kernels. *c*, White Spotted Ouszeo corn; 1-4, views of kernels. (Charlotte M. King.)

tened dorsally, and pointed, the lower part constricted by the closely embracing glume. In structure they are hard and corneous, with a central starchy layer extending from the base nearly to the apex. The

ripened ear breaks readily at the joint, so that the eight-rowed ear, for example, may be separated into several joints, each bearing two opposite pairs of kernels."

This maize has also been cultivated by Professor Bailey, who carried on some very interesting experiments with hybrids.

Prof. F. Lamson-Scribner has likewise cultivated the corn and had it under observation at Washington, D. C., and Knoxville, Tenn.

The writer has also had this corn under observation here at Ames. By giving the plant an early start in the greenhouse a few mature kernels were developed late in the season. It had all the characters first described above by Doctor Watson, and showed no tendency to hybridize with the varieties of maize occurring alongside of it. The writer has also had under observation the so-called pop-corn of Mexico. The seed was kindly furnished me by Mr. Chas. N. Page, of the Iowa Seed

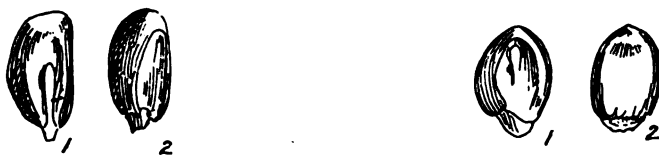


FIG. 12. Mexican pop-corn. Iowa Seed Co. (Charlotte M. King.)

Company. In their growth the plants resembled our ordinary pop-corn. They were, however, taller with larger spaces between the internodes; in addition they "suckered" somewhat. It appears to me that these Mexican pop-corns are distinct from the *Zea canina*.

Doctor Harshberger, who is certainly a most careful observer, and who carried on some interesting experiments on hybrids, considers our maize a hybrid between *Euchlaena* and *Zea canina*.

3. COIX.

Coix. L. Gen. Pl. No. 704. 1737 (Ed. 1.); No. 1043. 1764 (Ed. 6); Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20:14 f 4.

DESCRIPTION.

JOB'S TEARS. Spikelets unisexual, monoecious, spicate. Staminate spikelets in twos or threes at the joints of the rachis, one-half flowered. Empty glumes slightly unequal, rigid or herbaceous, inclosing the hyaline flowering glumes and palea. Stamens 3, pistil none. Pistillate spikelets, 1 or 2 at the base of the inflorescence, inclosed or surrounded by a nearly glabrous capsule-like covering, from the apex of which the staminate inflorescence projects; glumes thin-membranaceous

or sub-hyaline. Styles very long. Stigmas distinct, with short, papillose-villous hairs. Grain glabrous or oblong, closely embraced within the hardened covering inclosing the pistillate spikelets. Tall, leafy and much



FIG. 18. *Coix lachryma-jobi* L., Job's tears.—a, A pair of staminate spikelets; b, ovary; c, pistil, with rudimentary stamens. (Div. Agros. U. S. Dept. Agri.)

branched grasses, usually with many pedunculate spikes from the upper leaf-sheaths.

Species 3 or 4; three confined to the East Indies, the fourth is widely distributed throughout the tropics of both hemispheres: the *Coix lachryma jobi* cultivated in Iowa.

4. TRIPSACUM.

Tripsacum L. Syst. 2: 1261. 1759 (Ed. 10); Scribner, Bull. U. S. Dept. Agri. Div. Agros. 20:13 f 3. *Endlicher*. Gen. Pl. 106. *Bentham & Hooker*. Gen. Pl. 3: 1113.

TRIPSACUM DACTYLOIDES.

DESCRIPTION.

GAMA GRASS. Spikelets monoecious, in jointed unilateral spikes, staminate above, and fertile below. Staminate spikelets in pairs, sessile at each triangular joint of the narrow rachis, both alike, two-flowered, longer than the joints; glumes 4, coriaceous, the lower (outer) one-nerved, the second boat-shaped, the upper with the palea very thin and membranaceous, awnless; anthers opening by two pores at the apex. Pistillate spikelets two-flowered (the lower flower neutral) single and deeply imbedded in each oblong joint of the cartilaginous thickened rachis, occupying a boat-shaped recess which is closed by the polished and cartilaginous, ovate outer glume, the inner glume much thinner and pointed, the upper with the palea very thin and scarious, pointless. Styles united; stigmas very long (purple), hispid. Grain ovoid, free. Culms stout and tall, solid, from very thick, creeping rootstalks. Leaves broad and flat. Spike axillary and terminal, separating spontaneously into joints at maturity. (Name from the Greek word for *to rub*, perhaps in allusion to the polished fertile spike.)



FIG 14. *Tripsacum dactyloides* L. Gama grass. a, Two joints of the pistillate portion of the spike; b, a pistillate spikelet; c, outer glume of the same; e, flowering glume and palea showing the long exserted stigmas; f, staminate spikelet.

DISTRIBUTION.

Iowa. Appanoose County, Decatur County (Fitzpatrick); Muscatine (Repper); Decatur County, Van Wert (Hitchcock).

North America. New York, Pennsylvania, Connecticut, Maryland (Holm); Glen Echo, D. C. (Kearney); to Illinois, Iowa, Missouri (Eggert); St. Louis (Pammel); Florida (Jacksonville, Curtiss; Duval County, Curtiss); Arkansas, Texas and Mexico.

General. Trinidad and Brazil.

TRIBE II. ANDROPOGONEÆ.

Spikelets in spike-like racemes, two at each joint of the articulate rachis, one sessile and hermaphrodite, one pedicellate, the latter hermaphrodite, staminate, neuter, or reduced to the pedicel alone; glumes

usually four, the first and second empty, larger and much firmer in texture than the others, the third usually empty, with a staminate flower in the axil, very rarely awned, the fourth or flowering glume hyaline, usually awned, awn usually twisted or geniculate.

This tribe contains upwards of 400 species divided among 29 genera, of which *Andropogon* contains 190 species. This is one of the largest and most important because they make excellent forage plants. Several of these plants are used in medicine.

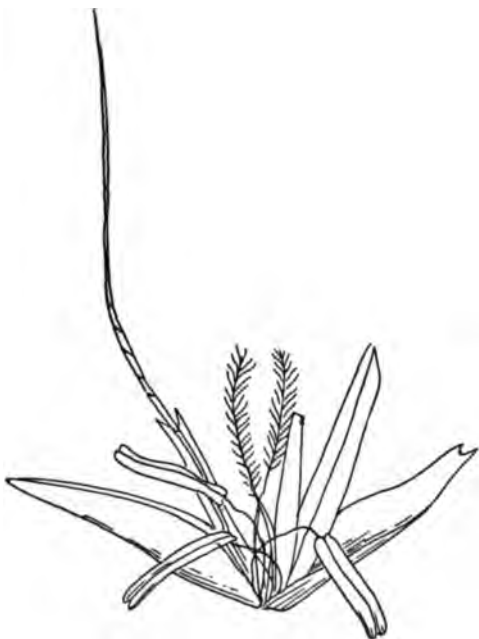


FIG. 15. Spikelets of *Andropogon furcatus*.

Sugar cane (*Saccharum*) belongs to this tribe. Well known representatives of this tribe are blue stem (*Andropogon provincialis*, *A. nutans*). Sorghum, of which there are many varieties, is a well known plant cultivated in Iowa.

KEY TO THE GENERA OF THE ANDROPOGONEÆ.

Spikelets all alike, perfect (homogamous).

Axis of racemes continuous; racemes in somewhat fan-shaped panicles.

—MISCANTHUS.¹

Axis of racemes articulate; racemes in an elongated, dense panicle.

Spikelets awned.....ERIANTHUS. 2.

Spikelets awnless.....SACCHARUM. 3.

Spikelets not all alike, the sessile perfect; the pedicellate staminate, empty or reducedANDROPOGON. 4.

1. MISCANTHUS.

Miscanthus. Anders. Ofvers. Vet. Akad. Forh. Stock. 12: 165. 1855. Benth. & Hooker. Gen. Pl. 3: 1125 Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2:23. *Eulalia* Trin. in part, Munro. Benth. Fl. Hongk. 420 Kunth. *Eulalia* Kunth. End. Gen. Pl. 107. Kunth. Gram. 160. pl. 93. Agros. 479.



FIG. 16. *Miscanthus Japonicus* Anders. *Eulalia*. —a, A spikelet; b, dorsal view of the first glume; c, similar view of the second glume. (Div. of Agros. U. S. Dept. of Agrl.)

DESCRIPTION.

EULALIA. Spikelets all alike, one-flowered, hermaphrodite, in pairs along the continuous branches of a terminal, spreading panicle, the rachilla articulated below the empty glumes. Glumes 4, the first two membranaceous, nearly equal, empty; the third less firm in texture, empty; the fourth or flowering glume hyaline, more or less bifid at the apex and usually awned between the teeth. Palea hyaline, stamens 3.

Rather tall, usually showy grasses with the numerous slender racemes of the terminal panicle more or less spreading.

Species 8. South Africa, eastern Asia and Japan. One species, *Miscanthus Japonicus* occasionally cultivated under the name of *Eulalia Japonica*.

2. ERIANTHUS.

Erianthus. Michx. Flor. Bor. Am. 1: 54. 1803. Hackel in Engler & Prantl Nat. Pflanz. Fam. II. 2: 24. f. 14. Endlicher. Gen. Pl. 107. Benth. & Hooker. Gen. Pl. 3: 1126. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 19 f. 8.

DESCRIPTION.



FIG. 17. *Erianthus compactus*. Nash. Densely-flowered Plume Grass. —a, A spikelet; b, first glume; c, second glume; d, third glume; e, fourth or flowering glume; f, lodicules. (Div. Agros. U. S. Dept. Agr.)

PLUME GRASS. Spikelets in pairs, one sessile, the other pedicellate, along the articulate and readily disjointed panicle-branches, both alike, hermaphrodite. Glumes 4, the outer ones subequal, firm-membranaceous, the first flattened on the back and more or less bicarinate and two-toothed at the narrowed apex; the second somewhat rounded on the back, sharply acuminate-pointed, and more or less keeled above; the third empty and usually hyaline, awnless; the fourth awned and enclosing a hermaphrodite flower. Palea usually much shorter than its glume, nerveless; lodicules cuneate, ciliate, or naked. Tall, reed-like, perennials, with the spikelets in many-

jointed racemes, which are sessile along the main axis, forming an ample terminal and usually woolly panicle.

Species about 18, chiefly in the warmer regions of both hemispheres. Southern North America, Central America, Australia, Africa, Asia, China and Japan, Europe and Brazil.

3. SACCHARUM.

Saccharum. L. Sp. Pl. 1: 79. 1762. (ed. 2.). Bentham & Hooker. Gen. Pl. 8: 1125. Endlicher Gen. Pl. 107. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 23. f. 13. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 18. f. 7.

DESCRIPTION.

SUGAR CANE. Spikelets all alike, perfect, awnless, in numerous, jointed racemes, forming a much branched terminal panicle. The



FIG. 18. *Saccharum officinarum* L. Sugar cane.—a, A portion of a branch of the inflorescence with two spikelets attached; b, spikelet; c, flower.

somewhat hardened first and second glumes empty, equal, awnless, empty and hyaline; the fourth or flowering glume awnless, or simply mucron-

ate-pointed, hyaline. Tall, erect, perennials, with usually simple culms, long leaves, and ample terminal panicles; the small spikelets surrounded by long silky hairs. Allied to *Erianthus*.

Species 12, chiefly in the tropics of the Old World; one species cultivated.

Saccharum officinarum is cultivated in tropical countries, and in the southern states along the gulf coast. Occasionally cultivated in greenhouses in Iowa.

4. ANDROPOGON.

Andropogon. L. Sp. Pl. 1045. 1753. Endlicher Gen. Pl. 108. Bentham & Hooker. Gen. Pl. 3: 1133, 1135. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 26. Scribner. Bull. U. S. Dept. Agri. Div. Agros. 20: 24. f. 13.

DESCRIPTION.

BEARD GRASS. Spikelets in pairs upon each joint of the slender rachis, spiked or racemed, one of them pedicelled and sterile (staminate, pistillate or neutral) often a mere vestige, the other sessile, one-flowered and fertile; lower glume the larger, coriaceous and nerved, blunt, the second carinate and acute, the two upper hyaline, the flowering glume awned from the tip. Stamens 1-3. Grain free. Coarse, mostly rigid perennials, mostly in sterile or sandy soil; with lateral or terminal spikes commonly clustered or digitate; the rachis hairy or plumose-bearded, and often the sterile or staminate flowers also, (whence the name composed of two Greek words for *man* and *beard*.)

There are about 200 species, chiefly in warmer parts of North America, Asia and temperate Europe.

North America has 37 species, chiefly in the western states; southern states about 25; western Texas 14; Canada 4; eastern states 8; Rocky Mountains 6.

Europe has 9 species.

KEY TO THE SPECIES OF ANDROPOGON.

Inflorescence of spike-like racemes.

Racemes single.....*A. scoparius*.¹

Racemes in pairs or more.

Hairs on pedicels and rachis joints copious, equalling them in length, awn straight, 4-10 mm. long or wanting*A. Hallii*.²

Hairs on rachis joints and pedicels sparse and shorter.

Spikelets 6-8 mm. long, outer scales mostly smooth.

—*A. provincialis*.³

Spikelets 8-10 mm., outer scales very rough-scabrous.

—*A. Tennesseensis*.⁴

Inflorescence paniculate.

Pedicelled spikelet wanting (in one species) (*Chrysopogon*)...*A. nutans*.¹

Pedicelled spikelet present (*Sorghum*).

Perennial from stout rootstocks.....*A. Halepensis*.²

Annual, cultivated.....*A. Sorghum*.¹

1. ANDROPOGON SCOPARIUS.

Andropogon scoparius. Michx. Fl. Bor. Am. 1: 87. 1803. Watson and Coulter. Gray. Man. Bot. 637. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 21. f. 6. 1894. Bull. U. S. Dept. Agr. Div. Agros. 7: 19 f. 13. 1900. (3 ed.) Beal. Grasses of N. A. 2: 46. 1896. Nash in Britton and Brown, Ill. Fl. 1: 101. f. 216. 1896.

DESCRIPTION.

LITTLE BLUE STEM. A rather slender perennial, one to three feet high, more or less paniculate-branched above, the single racemes terminal on the culms or branches. Culms somewhat compressed below. Leaf-sheaths carinate, smooth, scabrous or often pilose; ligule about a line long, truncate, leaf blade blade 2 to 10 inches (4-20cm.) long, 1 to 3 inches (2-6 mm.) wide, very acute, the mid-vein prominent below. Spathe 1 to 2 inches (2-5cm.) long, narrow and acute, or with a short rudimentary blade, apex of the peduncle smooth or sparingly pilose. Racemes partially enclosed within the spathe, or more often exserted, erect in flowering, 6 to 12 jointed, the rachis straight or usually flexuose; joints rather slender, somewhat thickened above, rounded and scabrous on the back, flattened on the anterior face, pilose on the edges from near the middle, the hairs increasing in length towards the apex, about one-half the length of the sessile spikelet. Pedicellate spikelet reduced to a



FIG. 20. *Andropogon scoparius*.—a, Spikelet; b, c, first and second glumes; d, third glume; f, lodicules; (U. S. Dept. Agr. Div. Agros.)

short-awned, narrow glume, which usually encloses a smaller one, rarely a staminate flower. Pedicel a little shorter than the sessile spikelet, flattened and broader above, spreading when dry; pilose along the edges, the hairs increasing in length above. Sessile spikelet narrow, lanceolate, appressed to the rachis, 3 to 5 lines (6-10 mm.) long; first glume rigid, herbaceous-chartaceous, sharply two-keeled with narrow strongly inflexed margins, keels scabrous; second glume about the length of the first, lanceolate, acuminate, or short-awned, one-nerved, scabrous on the keel and more or less ciliate on the margins; third glume deep purple or violet, the infolded margins ciliate on the edge; fourth a little shorter than the third, narrowly oblong, ciliate along the margins, more or less deeply bifid at the apex and awned between the acute divisions; awn 4 to 9 lines (8-18 mm.) long, with closely twisted basal portion (the column) barely exceeding the outer glumes. The grass is common throughout the state, especially on gravelly hills and upland prairies. Abundant on the loess bluffs along the Missouri river. A valuable forage plant.

DISTRIBUTION.

Iowa. Plymouth County (Brown); Cedar Rapids (Pammel); Lansing 3161 (Miss King); Sioux City 107 (Miss Wakefield); Kosuth County 1022, Sioux City, Eagle Grove, Carroll, Des Moines 705, Cedar Rapids, Dakota City, Turin, De Witt 1461, Carnarvon 294, South Dakota opposite Hawarden, Iowa, Columbus Junction 1518 (Pammel); Ledyard 759 (Pammel and Cratty); Mt. Pleasant 864 (Mills); Ames, Greenfield, Stewart, Ames (Bessey, Beardslee and Hitchcock); Winterset 266, Des Moines (Carver); Ames 911 (Ball); Mt. Ayr 641 (Beard); Creston 1012 (Bettenga); Carroll 1019 (Simon); Wilton (Hitchcock); Belknap 823 (Rankin); Muscatine (Reppert); Lyon County 48 (Shimek); Bartlett 780 (Baldwin); Charles City 834 (Anderson); Fayette 1086 (Fink); Ft. Dodge 2221 (Pammel and Sokol); Myron (Miss King); Lyon County (Shimek); Iowa City (Preston); Ames (Hitchcock); Iowa City (Miss Linder); Plymouth and Woodbury Counties (O. F. Brown); Carnforth (Pammel); Mason City (Pammel); Steamboat Rock, Pine Creek (Miss King); Slater (Fawcett); State Center (Pammel); Milford (Shimek); Steamboat Rock (Shimek).

North America. New England south to Florida, Georgia, Alabama and Tennessee; northwest to Illinois, Wisconsin, Minnesota, Iowa; south to Missouri and Texas (College Sta., Pammel), Colorado (Ft. Col-

lins, La Poudre River, Pammel and Johnson), in Canada from Ontario to Saskatchewan.

2. ANDROPOGON HALLII.

Andropogon Hallii. Hack. Sitz. Akad. Wiss. Wien 89: 127. 1884. Watson and Coulter. Gray. Man. Bot. 633. 1890. (6th ed.) Beal. Grasses of N. A. 2: 54. 1896. Nash in Britton and Brown, Ill. Fl. 1: 101. f. 218. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 26. f. 319. 1899.

DESCRIPTION.

TURKEY FOOT GRASS, COLORADO SAND GRASS, HALL'S BEARD GRASS. A stout, glabrous perennial, 2 to 7 feet (4-10 dm.) or more high, with rather long, the lower 4 to 8 inches (10-20 cm.), flat leaves and stout racemes, which are in pairs, or in threes, and 2 to 3 inches (5-8 cm.) long. Sessile spikelet about 4 lines (8 mm.) long, with the first glume ciliate along the keel and pilose-hairy towards the apex. Awn shorter than the spikelet, or wanting. Dry, sandy soil.

North Dakota, Montana southward to Kansas, Texas and New Mexico. In western Nebraska and westward it is a valuable grass for stock. July to September. This species is not native but has been introduced near Muscatine.



FIG. 21. *Andropogon Hallii*. For details, see fig. 20. Div. Agr. U. S. Dept. Agr.

DISTRIBUTION.

Iowa. Muscatine, 1417 (Barnes and Miller).

North America. Iowa, Kansas, Nebraska, Montana and New Mexico.

3. ANDROPOGON PROVINCIALIS.

Andropogon provincialis Lam. Encycl. 1: 376. 1783. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 22. f. 7. 1894. Bull. U. S. Dept. Agrl. Div. Agros. 7: 20. f. 14. 1900. (3d ed.) Beal. Grasses of N. A. 2: 55. 1896.

Andropogon furcatus Muhl. Watson and Coulter. Gray Man. Bot. 637. pl. 14. 1890. (6th ed.) Nash in Britton and Brown, Ill. Fl. 1: 102. f. 219. 1896. Sub. var. *furcatus* Hack. D. C. Mon. Phan. 5: 442. 1889.

DESCRIPTION.

BLUE STEM. A stout perennial, 2 to 5 feet (5-12 dm.) high with rather thick racemes, two to five together, terminal on the culm and its branches. Culms smooth, terete, often pruinose below the nodes, branched above; branches single (rarely two or four together)

simple. Sheaths smooth or sometimes pilose, those of the sterile shoots usually compressed-keeled; ligule very short ($\frac{1}{2}$ to 1 line) truncate; leaf-blade 8 inches to 2 feet (2-5 dm.) long, 2 to 5 lines (4-10 mm.) wide, tapering into long, setaceous points, margins scabrous, and often fimbriate near the base. Spathes usually about four inches long, smooth, acuminate pointed. Racemes at length long-exserted, two to eight together, closely approximate along the shortened common rachis, appearing digitate, more or less spreading, densely flowered; joints about one-half the length of the sessile spikelet, usually with a dentate appendage at the imperfectly cup-shaped apex, somewhat flattened and ciliate along the edges, the longer upper hairs one-half



FIG. 22. *Andropogon provincialis* Lam. Big Blue Stem —a, A sessile and pedicellate spikelet; b, first glume of the sessile spikelet; c second glume of the same; d, third glume; e, fourth or flowering glume which is awned; f, palea; g, lodicules.

as long as the pedicel. Pedicellate spikelet lanceolate, staminate, with four glumes; first glume lanceolate, acuminate or mucronate pointed, serrulate-scabrous along the scarcely infolded margins, smooth on the back or punctate scabrous above, 7-11 nerved; callus naked or shortly pilose; second glume a little shorter than the first, lanceolate, acute, 3 to 5 nerved, the hyaline margins ciliate; third glume equalling the second, the fourth somewhat shorter, both 1 to 3-nerved, lanceolate and acute. Palea small. Sessile spikelet $3\frac{1}{2}$ to $5\frac{1}{2}$ lines (7-11mm.) long, narrow-lanceolate, acute; first glume coriaceous, very acute or sometimes long acuminate-pointed, apex minutely bimucronate, margins strongly inflexed, keels aculeolate scabrous, the back punctate scabrous or smooth below, callus barbate, the hairs about one-fourth as long as the glumes; second glume equalling the first, lanceolate, boat-shaped, acuminate or mucronate, one-nerved, keel scabrous, the narrow infolded and hyaline margins ciliate; third glume a little shorter than the second, lanceolate, imperfectly 3-nerved, the infolded margins ciliate; fourth glume somewhat shorter, lanceolate, more or less deeply bifid at apex, the divisions acute, ciliate on the margins, 3-nerved near the base, awned; awn six to eight inches long, with the column slightly exerted from the glumes. Palea one-half to two-thirds as long as its glume, fimbriate at apex. Anthers yellow, one and one-half lines long. Stigmas purple.

Common throughout the state. A common prairie grass, also abundant in the alluvial bottoms of the Missouri river. August to October. A valuable forage plant originally extensively used for hay.

DISTRIBUTION.

Iowa. Slater (Fawcett); Steamboat Rock (Miss King); Ledges, Boone County (Buchanan); Plymouth County (Brown); Charles City (Pammel); Lansing 3158 and 3011, Steamboat Rock 3013, Postville 3353, Myron 3110 (Miss King); Lawler (R. H. Rolfs); Pilot Mound 3057 and 3060 (MacCorkindale and Miss King); Chariton 768 (Mallory); Humboldt 645 (Wells); Mt. Pleasant 680 (Dr. Witte); Mt. Ayr 636 (Beard); Sioux City (Miss Wakefield); Fayette (Fink); Marshalltown (Stewart); Ames (E. R. Wilson, Fairfield, Hitchcock, Bessey, Beardslee, Crozier, Ball 118, Pammel 104); Turin, Slater, South Dakota opposite Hawarden, Sioux City, Carroll, Hawarden, De Witt 1459, Carnarvon 232, Muscatine (Pammel); Emmet County 812 (Pammel and Cratty); Ledyard 757 (Pammel and Cratty); Armstrong 1077 (Cratty); Winterset (Carver); Tabor 777 (Baldwin and Pammel); Boone County 842 (Steele); Charles City 836 (Anderson); Belknap 824 (Rankin); Dallas 748 and 818

(Rhinehart); Iowa City (Hitchcock); Appanoose County (Fitzpatrick); Mt. Pleasant (Mills); Cedar Rapids (Miss Hall); Dixon 1017 (Spencer); Creston 1010 (Bettenga); Rock Rapids 33, Spirit Lake 13, Forest City 22, Hancock County (Shimek); Forest City 709 (Peters); Manchester 1038 (Ball); Carroll 1016 (Simon); Myron (Miss King); Muscatine (Reppert); Council Bluffs (Miss Cavanagh and Dilne); Armstrong (Shimek); Nora Junction 59 (Shimek); Algona (Watson); State Center (Pammel); Milford (Shimek); Oskaloosa (White).

North America. Maine south to Florida; west to Kentucky and Tennessee and Alabama; Texas (Collins County, Pammel); Wisconsin, La Crosse (Miss Pammel); through Kansas, Iowa, the Dakotas, Minnesota and Colorado, Ft. Collins (Pammel and Johnson, Crandall).

General. Introduced into southern France.

4. ANDROPOGON TENNESSEENSIS.

Andropogon Tennesseensis Scribner. U. S. Dept. Agr. Div. Agros. 16: 1.

Andropogon provincialis var. Tennesseensis Scrib. U. S. Dept. Agr. Div. Agros. 7: 23. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 23. 1894.

DESCRIPTION.

TENNESSEE BLUE STEM. Pedicellate spikelet usually hermaphrodite, 8-10 mm. long, the first glume lanceolate, acuminate, rounded on the back, 11-13 nerved, apex acute, sub-aristate or minutely bimucronate, scabrous all over the back and especially on the nerves and margins.

Second glume 7-9 nerved, lanceolate, acute or sub-aristate, scabrous on the back above and ciliate along the hyaline, infolded margins above. Third glume about as long as the outer ones, lanceolate, acute, scabrous on the back above and fimbriate-ciliate along the margins. Fourth glume shorter than the third, apex bifid, ciliate on the margins above, awned. Awn slender, a little twisted, 2-4 mm. long. Palea $\frac{1}{4}$ - $\frac{1}{3}$ as long as its glume. Stamens and pistil as in the sessile spikelet. Sessile spikelet about 8-10 mm. long, more than twice as long as the pedicels. First glume rigid and very rough-scabrous all over the back, ciliate-scabrous along the keels above. Second glume compressed and strongly keeled, long acuminate pointed, scabrous on the sides and very rough on the keels, ciliate on the narrowly inflexed margins above. Third glume a little scabrous on the back above. Racemes as in *A. provincialis*. Hairs on pedicels and joints yellow. Pedicels and outer glumes very rough scabrous.



FIG. 28. *Andropogon Tennesseensis*. Scribner. Tennessee Blue stem.—a, b, awned and pedicellate spikelets; f, flowering glume; awn at g.

DISTRIBUTION.

Iowa. Ames 102, 104 (Pammel, Stewart, Hitchcock); Greenfield (Stewart); Dakota City (Pammel); Amana 701 (Schadt); Bartlett 780 (Baldwin, Pammel); Iowa City, Preston, Lake Edwards, Hancock County (Shimek); Delaware County, Cameron, Arnold's Park (Shimek).

North America. Tennessee to Iowa, Nebraska and Texas.

5. ANDROPOGON NUTANS.

Andropogon nutans L. Lamson-Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 26. f. 12. 1894.

Andropogon nutans avenaceus (Michx.) Hack. Beal. Grasses of N. Am. 2: 59. 1896. Lamson-Scribner. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 7: 21. f. 15, 1900. (3 ed.)

Chrysopogon avenaceus (Michx.) Benth. Nash in Britton and Brown, Ill. Fl. N. States and Can. 1: 104. f. 224. 1896.

Chrysopogon avenaceus Benth. Jour. Linn. Soc. 19: 73. 1881.

Chrysopogon nutans Benth. Watson and Coulter in Gray Man. Bot. 638. 1890 (6 ed.)

Andropogon avenaceus Michx. Fl. Bor. Am. 1: 58. 1803.

Sorghum avenaceus Chap. Fl. Southern States. 583. 1860.

Sorghum nutans A. Gray. Man. 617. 1848.

DESCRIPTION.

INDIAN GRASS. Culms simple, 3 to 5 feet (7-12 dm.) high, terete, smooth, often bearded at the nodes. Sheaths smooth, extending into a rigid ligule 1 to 3 lines (2-6 mm.) long; leaf-blade narrowly lanceolate, 3 to 8 lines wide, 10 inches to 2 feet (2-5 dm.) long, narrowed at the base and tapering into a long, slender apex. Panicle 6 to 12 lines (1-2½ cm.) long, lax, or sometimes rather densely flowered, nodding at the apex; primary branches solitary, straight ascending, repeatedly branching from the base; ultimate branches filiform, and a little pilose below the spikelets, straight, or somewhat flexuose. Racemes short, 1 to 4-jointed, bearing one to four spikelets, joints filiform, flexuose, shorter than the spikelets, ciliate. Spikelets 3 to 4 lines (6-8 mm.) long, shining, usually pale reddish brown (sometimes very dark brown) lanceolate; first glume coriaceous, more or less pilose, broadly lanceolate or narrowly oblong, apex truncate, flat or slightly convex on the back, 5 to 9-nerved, margins subinvolute; callus short, obtuse, white-barbate; second glume similar in texture, narrower, fewer nerved and a little longer than the first, obtuse or with a depressed triangular apex; third glume as long as the first, hyaline, nerveless, obtuse, ciliate on the margins; fourth glume a little shorter than the third, ovate-lanceolate, three-nerved, ciliate, apex bidentate or bifid, awned between the divisions. Palea small, fringed at the broad apex, sometimes wanting. Pedicel very slender, plumose, shorter than the sessile spikelet, to which it is appressed. Dry fields,



4. Bushy blue stem, (*Andropogon nutans*) One of the valuable native Iowa grasses common on the edges of woods, and on prairies. (Charlotte M. King.)

glades and borders of woods, Ontario to South Dakota and Manitoba south to Florida, Texas and Arizona. Abundant throughout the state. A good forage plant. July to October. Our form is usually referred to *A. avenaceus*, the typical *A. nutans* having a longer awn and is supported on a column distinctly bent at about the middle. Has been found in Tennessee and Kentucky.

DISTRIBUTION.

Iowa. Steamboat Rock, Pine Creek (Miss King); Muscatine, 1258 (Reppert and Pammel); Mt. Pleasant, 859 (Mills); Mason City (Pammel); Slater (Fawcett); Kossuth County (Pammel and Cratty); Ames, 105 (Ball, Bessey, Beardslee, Pammel, Crozier, Sirrine, Hitchcock, Kaufman, Hodson); Dakota City, Hawarden, Sioux City, Jewell Junction 1293, Turin, Carroll, Cedar Rapids, De Witt, 1445 Clinton (Carnarvon, Pammel); Marshalltown (Stewart); Emmet County, 926 (Pammel and Cratty); Sioux City (Miss Wakefield); Winterset (Carver); Greenfield (Stewart); Armstrong, 1076 (Cratty); Muscatine (Reppert); Fayette (Fink); Creston (Betenga); Decatur County (Fitzpatrick); Des Moines (Carver); Johnson County 30, Rock Rapids 25, Granite (Shimek); Lawler (P. H. Rolfs); Chariton (Mallory); Ft. Dodge, 2238 (Pammel and Sokol); Mt. Ayr, 635 (Beard); Chariton, 678 (Mallory); Kossuth County, 925 (Pammel); Beloit (Shimek); Algona (Watson); Ledges, Boone County (Buchanan); Milford (Shimek).

North America. In dry fields or borders of woodlands. Ontario to New York and south to Florida; northwest to Kentucky, Tennessee, Arkansas (Rolfs), Missouri (Eggert), Illinois, Iowa, Kansas, the Dakotas, Wisconsin (La Crosse, Pammel), and Colorado (Ft. Collins, 1741, 893, Pammel and Johnson).

6. ANDROPOGON HALEPENSIS.

Andropogon Halepensis Brot. Fl. Lusit 1: 89. 1804.

Andropogon Halepensis (L.) Brot. Beal. Grasses N. Am. 2: 58. 1896. Bull. Bu. Plant. Ind. 11. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 25. f. 321. 1899.

Andropogon Sorghum Halepensis Hackel. Scribner. Grasses Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 27. f. 11. 1894.

Sorghum Halepense (L.) Pers. Nash in Britton and Brown Ill. Fl. N. States and Can. 1: 104. f. 225. 1896.

Sorghum Halepense Pers. Syn. 1: 105. 1805.

Holcus Halepensis L. Sp. Pl. 1047 1753.

DESCRIPTION.

JOHNSON GRASS. A stout perennial, with smooth, erect, simple culms, 3 to 5 feet (7-13 dm.) high, and strong creeping root-stocks. Leaves elongated, one-fourth to three-fourths inches wide, acute; ligule ciliate, and on the back where the leaf-blade joins the sheath there is more or less pubescence. Panicle open, 6 to 12 inches (12-25 cm.) long, the whorled branches naked below, the three to five flowered racemes clustered towards their extremities. Pedicels of the staminate (rarely neutral) spikelets pilose with stout hairs. Sessile spikelet broadly lanceolate, acute 2 to 3 lines (4-6 mm.) long, pale green or violet, becoming dark or nearly black at maturity. Callus small, obtuse, shortly and sparsely barbate. First glume coriaceous, sparingly pubescent on the flattened back, 5 to 7-nerved; second glume similar and equalling the first, convex below, subcarinate above, acute, the hyaline inflexed margins ciliate; third glume a little shorter than the outer ones, membranous, faintly two-nerved the infolded margins ciliate; fourth glume broadly oval, obtuse, nearly one-half shorter than the second, two-lobed or bidentate at the apex, ciliate, awned. Awn 5 to 8 lines (10-16 mm.) long. Palea a little shorter than its glumes, nerveless, ciliate. Introduced and cultivated in many of the southern states for hay. In many places it has become a dangerous weed, difficult to exterminate.



FIG. 25. *Andropogon Halepensis* Brot. For detail description, see fig. 20. (Div. of Agros. U. S. Dept. Agrl.)

C. R. Ball has given an excellent account of the methods of extermination, its description and its introduction in the southern states. It rarely prevails in Iowa as the plant cannot stand the severe winter climate of this state.

DISTRIBUTION.

Iowa. Wild Cat Den. (Reppert); Ames (Pammel, Stewart, Sirrine).

North America. In fields and waste places from southern Pennsylvania west to Missouri and Texas; all over the southern states.

General. Southern Europe, western Asia and Africa.



FIG. 28. *Andropogon Sorghum* and some of its varieties. 1, Kaffir corn; 2, Jerusalem corn; 3, Amber sorghum. (Kansas State Board of Agrl.)

7. ANDROPOGON SORGHUM.

Andropogon Sorghum. Brot. Fl. Lusit. 88. 1804.

Andropogon Sorghum var. *sativus* Hackel. D. C. Mon. Phan. 6: 505. 1889.

Andropogon Sorghum var. *Durra*. Hackel. The True Grasses. 59. f. 18. 1890.

Andropogon vulgare. Pers. Chapman Fl. Southern States. 583. 1883.

Holcus Sorghum L. Sp. Pl. 2: 347. 1753.

Sorghum vulgare Pers. Syn. 101. pl. 1. 1805.

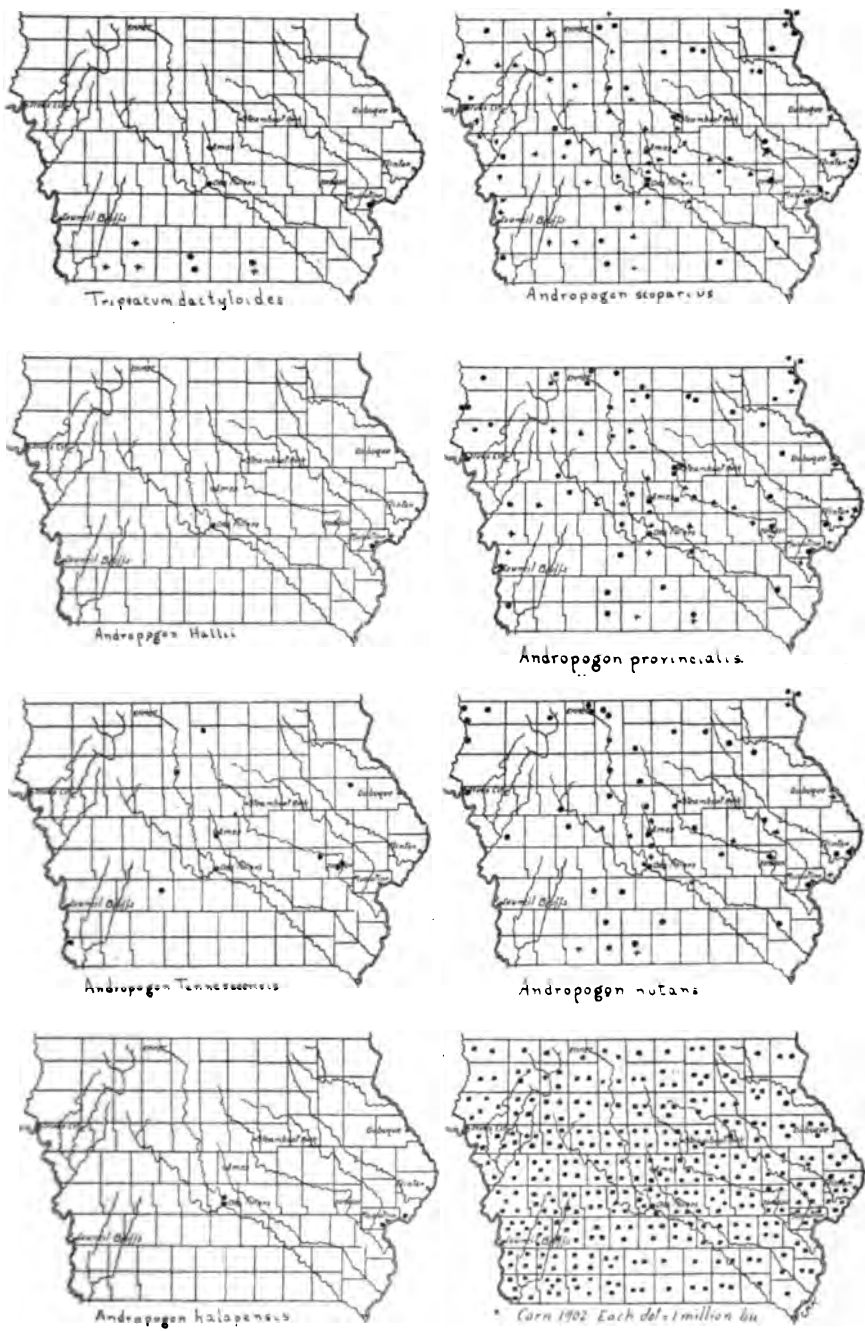


FIG 27. Distribution of *Tripsacum*, *Andropogon* and *Zea*.

DESCRIPTION.

SORGHUM. Fruit and spikelets usually larger and rounder than in *A. Halepensis*, and rachis not articulate; the var. *Durra.*, with more condensed panicles and deltoid spikelets. Culms 5 to 12 feet (12-30 dm.) high, with smooth, broad leaf, erect, rather compact, panicle, 4 to 8 lines (10-20 cm.) long, 3 to 5 lines (6-10 cm.) wide. Spikelets round, ovoid; lodicules red, hairy at the apex. Panicle usually dense, ovoid, 7½ inches (15 cm.) long. A very variable species.

The other common names of this grass are Guinea corn, millet, Indian millet, Imphee, Chinese sugar cane, Egyptian rice corn. In the south it is commonly known as chicken corn.

TRIBE III. OSTERDAMIÆ.

Spikelets solitary or in groups of 2 to 8, each group falling as a whole from the continuous rachis, usually 1-flowered, hermaphrodite, or staminate and hermaphrodite in the same group; flowering glume less firm in texture than the awned or awnless outer ones, which are herbaceous, chartaceous, or coriaceous; the first glume is usually larger than the second.



FIG. 28. A group of three spikelets of *Hilaria*.

This small tribe numbers about 25 species representing nearly half that number of genera. Fifteen of the species occur in the warm temperate regions of North America. Of the genera there are *Hilaria*, *Aegopogon*, *Nazia* and *Osterdamia*. *Hilaria* is not uncommon from Colorado to Mexico. One species, *Osterdamia matrella*, is cultivated under the name of *Korean lawn grass*.

1. OSTERDAMIA.

Osterdamia Neck. Elem. Bot. 3: 218. 1690. Bentham & Hooker Gen. Pl. 3: 1124. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 29. f. 17.

Zoysia Willd. Gesell. Nat. Fr. Berlin. n. Schr. 3: 440. Endlicher Gen. Pl. 106. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 31.

Osterdamia matrella Pers. Syn. Pl. 1: 73.

Spikelets subsessile or shortly pedicellate along the continuous rachis of the main axis, 1-flowered, hermaphrodite. Empty glumes 1, strongly compressed, keeled, awnless, coriaceous, inclosing the much smaller flowering glume. Stamens 3. Styles distinct; stigmas plumose.

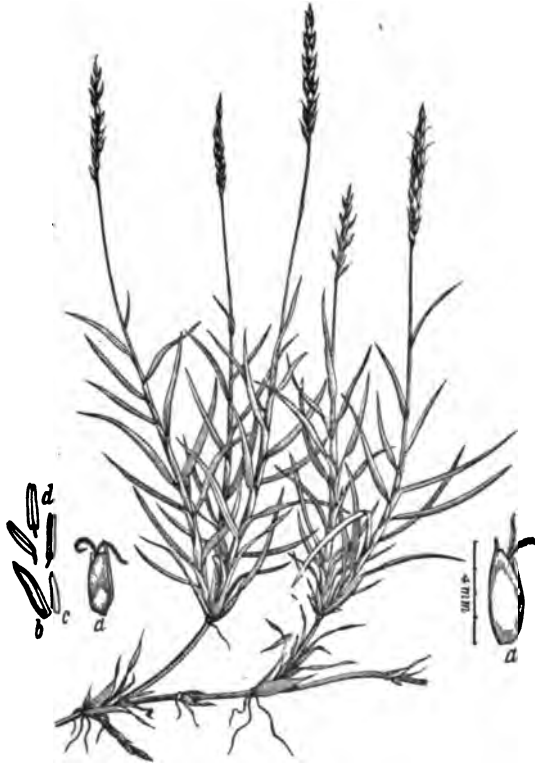


FIG. 29. *Oosterdamia matrella*. a, Spikelet with stigmas protruding; a smaller spikelet; b, second glume; c, palea; d, stamens. Div. Agros. U. S. Dept. Agri.

Grain included in the slightly indurated outer glume, free. Creeping or stoloniferous grasses with rather rigid, often sharp-pointed leaves, and slender, terminal spikes.

Two or three species in southern Asia, Mascaren Islands, Australia and New Zealand. *Osterdamia matrella* (*Zoysia pungens* Willd.) is a maritime grass and sand-binder.

TRIBE IV. TRISTEGINEÆ.

Spikelets all hermaphrodite, in panicles; empty glumes three, or the third with a staminate flower in its axil, herbaceous or chartaceous; flowering glumes membranaceous, awned or awnless; rachilla articulated below the empty glumes.

A small tribe of seven genera. Native of the tropical regions of the Old and New World. They are intermediate between the Andropogoneae and Paniceae.

TRIBE V. PANICEÆ.

Spikelets hermaphrodite, terete or flattened on the back; glumes three or four (rarely two); when four, there is occasionally a staminate flower or palea in the axil of the third; the uppermost or flowering glume of the hermaphrodite flower is always firmer in texture than the outer glumes, of which the first is usually smaller than the others; axis of the inflorescence not articulated, the rachilla being articulated below the empty glumes, the spikelets falling off singly from their pedicels.

FIG. 30. *Arundinella Nepalensis*, showing spikelet and awned flowering glumes (Trinius.)

This is a large and important tribe of the order Gramineae. Hackel recognizes 21 genera, while Bentham & Hooker recognize 30. Several of the Bentham genera should be excluded as not properly belonging to *Paniceae*. According to Britton & Brown there are 11 genera. The larger number given by Bentham is due in part to the splitting up of several genera, like *Panicum*. The principal genus is *Panicum*, of which there are about 300 species. The *Panicums* are widely distributed but are found chiefly in temperate regions. Crab grass is widely distributed, while millet is extensively cultivated in the Old World, and also in our northwestern states.

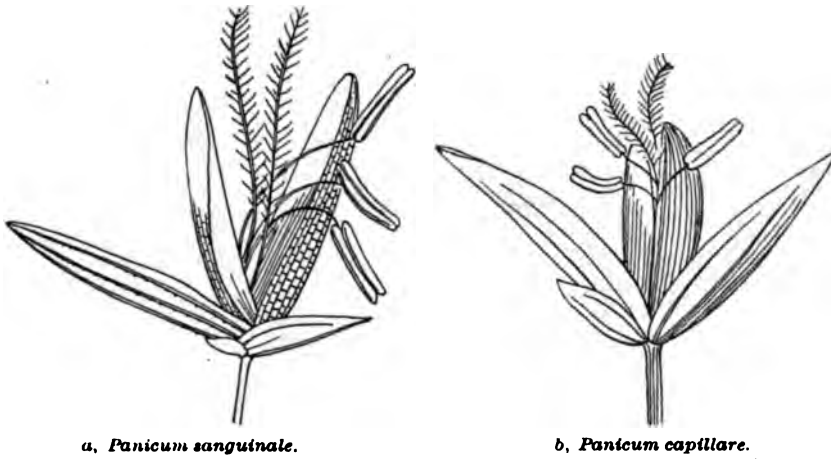
a, *Panicum sanguinale*.b, *Panicum capillare*.

FIG. 1. a, *Panicum Sanguinale* spikelet with three lower glumes, stamens and pistil (after Gray); b, *Panicum Capillare* spikelet with parts of the flower. (Charlotte M. King.)

KEY TO THE GENERA OF THE PANICEÆ.

Spikelets not subtended or surrounded by an involucre of bristles or spines;
perfect flower one.

Empty glumes two.....*Paspalum*.¹

Empty glumes three, or two and the third glume staminate....*Panicum*.²

Spikelets subtended or surrounded by an involucre of one to many bristles
or spines.

Involucral bristles persistent, the spikelets falling out at maturity.

—*Setaria*.³

Involucral bristles falling off with the spikelets at maturity.

Bristles numerous, thickened or united below into a bur-like
structure.....*Cenchrus*.⁴

Bristles numerous, not thickened, delicate, plumose.....*Pennisetum*.⁵

1. PASPALUM.

Paspalum L. Syst. 2: 855 17:9. [Ed. 10.] Endlicher Gen Pl. 82. Hackel in Engler & Prantl. Nat. Pflanz Fam. II. 2: 33. f. 24. Bentham & Hooker. Gen. Pl. 3: 1097. Scribner Bull. U. S. Dept. Agr. Div. Agros 20: 33. (Rev.)

Spikelets spiked or somewhat racemed, in 2-4 rows on one side of a flattened or filiform continuous rachis, jointed upon very short pedicels, plano-convex, awnless, 1-flowered. Glumes 3 (rarely only 2) the terminal one flowering. Flower coriaceous, mostly orbicular or ovate, flat on the inner side, convex on the outer. Stamens 3. Spikes one or more, at or toward the summit of an elongated peduncle. (From the Greek name for Millet.)

Bentham & Hooker give the number of species as 160. Hackel gives the number as 38. Found chiefly in warm temperate regions in

both hemispheres. More abundant in America than in the eastern hemisphere. In South America they constitute an important part of the herbs of the Pampas.

KEY TO THE SPECIES OF PASPALUM.

Rachis much broader than the spikelets, spikes 3-7. *P. membranaceum*.¹
 Rachis narrower than the spikelets, spikes 1-3.....*P. ciliatifolium*.²

1. PASPALUM MEMBRANACEUM.

Paspalum membranaceum Walt. Fl. Carol. 75. 1788. Scribner Bull. U. S. Dept. Agrl. Div. Agros. 17: 30. f. 326. 1899. Nash in Britton and Brown. Ill. Fl. 1: 106. f. 228.



FIG. 82. *Paspalum membranaceum*.—a, portion of raceme; c and e, spikelets. (Div. of Agros. U. S. Dept. of Agrl.)

Paspalum Walterianum
 Schultes. Mant. 2: 166.
 1824. Vasey Contr. U. S.
 Nat. Herb. 3: 16. Chap-
 man Fl. S. St. 570.

DESCRIPTION.

WALTER'S PASPALUM.

A low creeping, semi-aquatic grass, with much branched, smooth stems $\frac{1}{2}$ to $2\frac{1}{2}$ feet long; short flat leaves, and 2 to 6 small raceme $\frac{1}{3}$ to $\frac{2}{3}$ inches long. Spikelets ovate, obtuse, about 2 mm. long, crowded in 2 rows on one side of the broad flat rachis which is 1 to $1\frac{1}{2}$ lines (2-3 mm.) long.

DISTRIBUTION.

North America. Occurs in moist or wet grounds from New Jersey, Maryland, Tennessee, Illinois, Missouri (St. Louis, Pammel), possibly in southern Iowa; south to Texas.

2. PASPALUM CILIATIFOLIUM.

Paspalum ciliatifolium Michx. Fl. Bor. Am. 1: 44. Nash in Britton and Brown. Ill. Fl. 1: 107. f. 232. 1896. Scribner. Grasses of Tenn. Univ. Tenn. Agrl. Exp. Sta. 7: 34. f. 22. 1894.

Paspalum setaceum var. *ciliatifolium* Vasey. Contr. U. S. Nat. Herb. 3: 17.

Paspalum setaceum var. *ciliatifolium* (Michx.) Vasey. Beal. Grasses of N. A. 2: 91. 1896. *P. dasyphyllum* Ell. Bot. S. C. & Ga. 1: 105, 1817.

DESCRIPTION.

CILIATE LEAVED PASPULUM. An erect or ascending perennial, usually about 2 feet (5 dm.) high, with long, flat leaves and slender often solitary, terminal and long peduncled axillary racemes. Sheaths pubescent with spreading hairs, rarely nearly smooth, the lower usually



FIG. 33. *Paspalum ciliatifolium*. -a, spikelet; b, c, empty glumes; e, palea, stamens and pistil.

purplish, the upper ones elongated and somewhat inflated; ligule very short; leaf-blade 5 to 12 inches (10-24 cm.) long, 3 to 6 lines (6-12 mm.) wide, usually papillate pilose on both sides and along the narrowly-cartilaginous margins, acute, tapering slightly toward the rounded base, the upper leaf usually cordate. Racemes terminal and axillary, 2 to 4 or 6 inches (4-8 or 12 cm.) long, the terminal solitary or with one or two approximate below it, and finally exerted on long naked pe-

duncles; rachis very narrow, somewhat flexuose and triangular, scabrous. Spikelets imperfectly 2 to 4-rowed, crowded or somewhat lax, 1 line (2 mm.) long and nearly as broad, rounded at the apex, smooth, or the larger glume minutely hairy near the margins above. Flowering glume with a distinct depression on the back near the base.

Paspalum ciliatifolium is local only in central and eastern Iowa. Muscatine Island.

DISTRIBUTION.

Iowa. Muscatine 509 (Reppert); W. Iowa (Burgess); Iowa City (Hitchcock); Woodbine (Bessey); Johnson County (Macbride).

North America. In dry soil of New Jersey, Pennsylvania, Maryland, Wisconsin (La Crosse, Pammel); Iowa, Missouri (St. Louis, Eggert); Kansas, near McDonald's Station, Florida (Baker), Alabama, Texas and Tennessee (Carroll County (Eggert).

ERIOCHLOA.

Eriochloa. H. B. K. Nov. Gen. et. Sp. Pl 1: 94. 1815.



FIG. 84. *Eriochloa mollis* 1. Spikelet, 2. Fourth glume. 3. Palea and pistil. 4. Third glume with staminate flower. (Div. Agros. U. S. Dept. Agrl.

Spikelets 1-flowered, hermaphrodite, rachilla articulated below the empty glumes, where it is expanded into a distinct, ring-like callos. Empty glumes 2, nearly equal, membranaceous, more or less acuminate-pointed the third or flowering glume slightly indurated, mucronate, or short awn-pointed; shorter than its glume. Stamens 3. Styles distinct; stigmas plumose. Caryopsis included within the hardened fruiting glume, free. Annual (?) or perennial grasses, with usually thin flat leaves and terminal panicles, composed of numerous, somewhat one-sided racemes.

Species 5 to 6, in the subtropical or warmer temperate regions of both hemispheres.

2. PANICUM.

Panicum L. Sp. Pl. 55. 1753. Endlicher. Gen. Pl. 83. Bentham & Hooker. Gen. Pl. 3: 1100. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 35. f. 26-27-28. Scribner Bull. U. S. Dept. Agr. 20: 37. Vasey. Contr. U. S. Nat. Herb. 3: 22. *Thalasium* Spreng. Syst. Cur. Post. 22: 30. *Panicum* as here defined includes *Digitaria*. Scop. Fl. Carn. 1: 52. 1772. (ed. 2.) which equals *Syntherisma*. Walt. Fl. Car. 76. 1788. and *Echinochloa*. Beauv. Agrost. 53: pl. II. f. II. Reichb. Ic. Fl. Germ. Pl. 39.

Spikelets jointed upon the pedicels, ovate, panicle, racemed, or sometimes spiked, not involucrate, with one perfect and sometimes a second lower rudimentary or staminate flower. Glumes 4, but the lower one usually short or minute (rarely wanting), and the third empty or sterile, membranaceo-herbaceous. Upper flower perfect, closed, coriaceous or cartilaginous, usually flattish, parallel with the glumes, awnless, enclosing the free and grooveless grain. Stamens 3. Stigmas plumose, usually purple. (An ancient Latin name of the Italian Millet, *Panicum*, now *Setaria Italica* of uncertain origin and meaning.)

There are about 300 species of *Panicum* found in the tropical and subtropical regions of both hemispheres. A comparatively small number occurring in temperate regions. Bentham & Hooker give the number of species between 250 and 280 but the number has considerably increased since the publication of their Genera Plantarum. The Hackel estimate of 300 is probably a conservative one. Of the 60 species in Australia several are common to Africa, Asia and America.

KEY TO THE SPECIES OF PANICUM.

I. Spikelets in one-sided racemes.

1. Racemes scattered (*Echinochloa*).

A. Sheaths glabrous.

a. Spikelets awned *P. Crus-galli*.¹

b. Spikelets awnless *P. Crus-galli* var *muticum*.²

B. Sheaths, at least the lower ones, papillose hirsute *P. Walteri*.³2. Racemes slender, digitate or whorled, sometimes in pairs. (*Syntherisma*.)A. Rachis of the racemes with the angles wingless. *P. filiforme*.⁴

B. Rachis of the raceme with the lateral angles broadly winged.

a. Sheaths and leaves smooth and glabrous... *P. glabrum*.⁵

b. Sheaths and leaves papillose hirsute..... *P. sanguinale*.⁶

II. Spikelets in a true panicle. (*Eupanicum*.)

1. Basal and culm leaves similar, usually elongated.

A. Culms branched (at least at maturity), no scaly root-stocks.

a. Sheaths very pubescent.

aa. Spikelets lanceolate, 3 mm. long or less.

† Annual, pedicels usually from two to three times the length of spikelets.

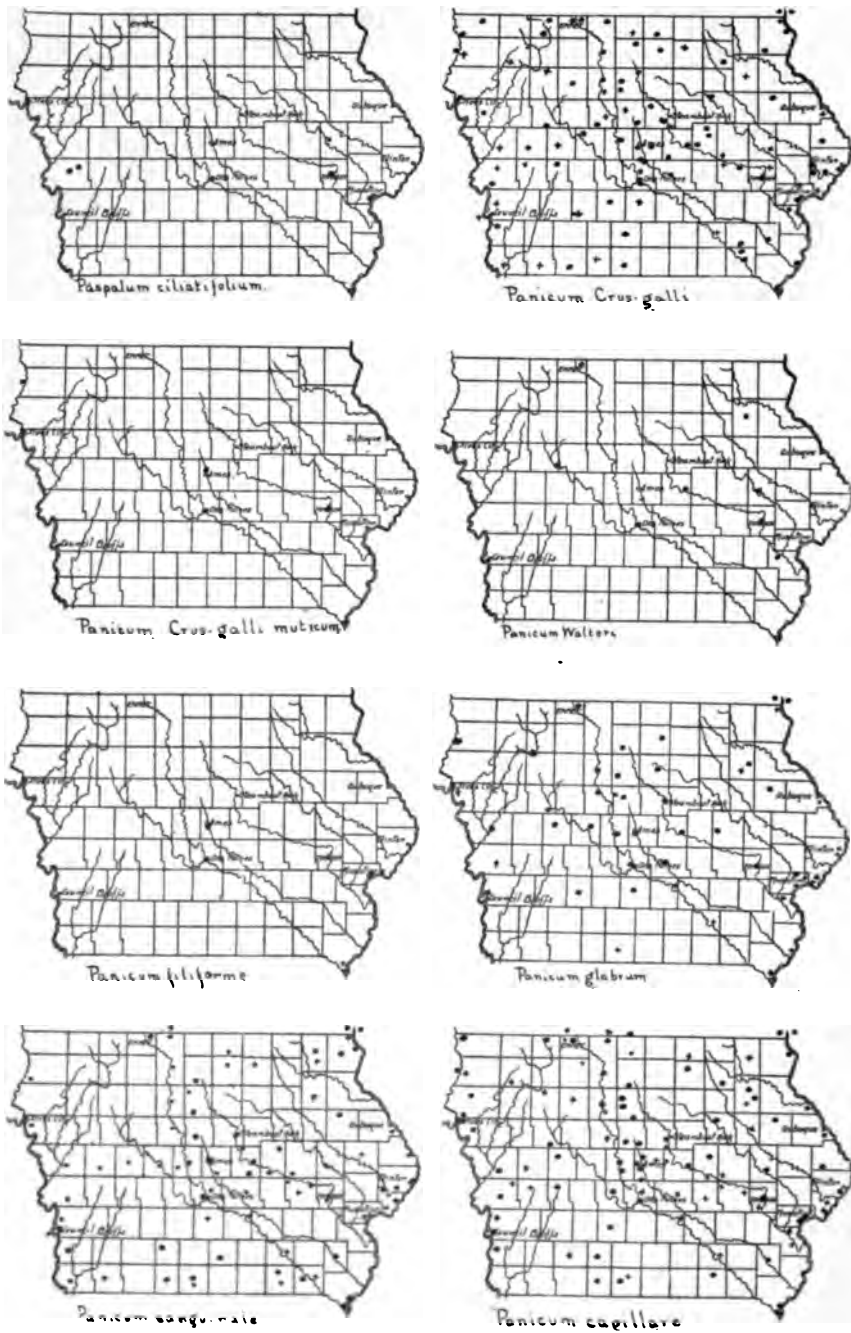


FIG. 35. Distribution of *Paspalum* and some *Lanicums*; †based on observations; ● specimens in herbarium.

- Culms stout, panicle branches numerous, repeatedly dividing and bearing numerous spikelets, 2-2.5 mm. long.....*P. capillare*.⁷
- Culms slender, panicle branches few, but little divided, bearing comparatively few spikelets, 1.5-2 mm. long.....*P. minimum*.⁸
- †† Perennial, pedicels usually many times longer than spikelets.....*P. cognatum*.⁹
- bb. Spikelets ovate, 5 mm. long.....*P. miliaceum*.¹⁰
- b. Sheaths glabrous.....*P. proliferum*.¹¹
- B. Culms simple, from stout scaly root-stocks.....*P. virgatum*.¹²
2. Basal and culm leaves dissimilar, the former generally much shorter and broader, rosulate tufts of leaves commonly present in the fall, spikelets oval, obovate or globose, obtuse except in *P. depauperatum*.
- A. Leaves linear, elongated, narrowed toward the base, erect, the broader basal leaves rarely evident; panicles small, few-flowered.
- a. Spikelets 3.5 mm. long, beaked, glabrous. *P. depauperatum*.¹³
- b. Spikelets 3-3.25 mm. long, obtuse, glabrous or with a few scattered long hairs.....*P. perlongum*.¹⁴
- c. Spikelets 2-2.5 mm. long, obtuse, pubescent.
—*P. linearifolium*.¹⁵
- B. Leaves narrowly to broadly lanceolate, rounded or clasping at the base, usually spreading.
- a. Panicle strict, narrow, the branches appressed.
—*P. xanthophysum*.¹⁶
- b. Panicle ovate, open, the branches spreading.
- † Leaf blades 2-4 cm. broad, cordate and clasping at the base.
- * Leaves glabrous or with scattered hairs, ciliate sheaths glabrous, ciliate nodes glabrous or the lower barbed.....*P. macrocarpon*.¹⁷
- ** Leaves and sheaths usually finely pubescent, nodes densely barbed.....*P. latifolium*.¹⁸
- †† Leaf blades less than 2 cm. broad, not cordate clasping.
- a. Spikelets over 3 mm. long.
- Leaves pubescent on both surfaces.
- Leaves erect, rigid, thick, 3-4 mm. wide; spikelets 2-5 mm. long.....*P. Wilcoxianum*.¹⁹
- Leaves mostly spreading, not thick, 5-10 mm. wide, spikelets 3-3.5 mm. wide.
—*P. Leibergii*.²⁰
- Leaves glabrous or pubescent beneath
—*P. Scribnerianum*.²¹
- aa. Spikelets 2 mm. long.....*P. Atlanticum*.²²
- aaa. Spikelets about 1.5 mm. long.
- Leaves thin, weak, papillate hairy beneath, spikelets pubescent.....*P. lanuginosum*.²³
- Leaves firm, densely pubescent beneath, spikelets pilose.....*P. unciphyllum*.²⁴

1. PANICUM CRUS-GALLI.

Panicum Crus-galli L. Sp. Pl. 26. 1753. Watson and Coulter in Gray. Man. 633. 1890. (6th ed). Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 39. f. 39. 1894. Bull. U. S. Dept. Agr. Div. Agros. 7: 70. f. 64. 1900. (3 ed). Scribner and Merrill. Rhodora 3: 93. Beal. Grasses of N. Am. 2: 119. 1896. Vasey. Contr. U. S. Nat. Herb. 3: 37. Nash in Britton and Brown, Ill. Fl. 1. 113. f. 243. 1896.

Oplismenus Crus-galli Kunth. Gram. 1: 44.

DESCRIPTION.

BARNYARD GRASS. A coarse, ascending or erect, leafy annual 1 to 6 feet (3-18dm.) high, with more or less dense panicles of numerous erect or spreading spikes 2 to 5 inches (5-12 cm.) long. Spikelets 1 to 1½ lines (2-3 mm.) long, densely and irregularly crowded in three or four rows along one side of the axis; first glume one-fourth to one-half as long as the third, pubescent or muriccate-hispid along the nerves, the second awnless or short awned, the third awnless or with a long rigid awn. Almost everywhere in the United States in barnyards, waste ground and river banks. Flowers all summer. Barnyard grass is common throughout the state; indigenous.



FIG. 36. *Panicum Crus-galli*.—a, spikelet showing first and third glumes; b, ovary, stigmata and palea. (Div. of Agros. U. S. Dept. of Agrl.)

DISTRIBUTION.

Iowa. Woodbury County (Brown); Milford (Skiff); De Witt, 1457 and 1448 Jefferson, 886 Ledyard, Dakota City, Clinton, Carnar-

von, 2263 Wilton Junction, Des Moines, 3204 Boone, Slater, Eagle Grove, Missouri Valley, South Dakota opposite Hawarden (Pammel); Hamilton to Hancock County (Preston); Des Moines County (Bartsch); 1353 Muscatine, Wheatland, 1020 and 1006 Manchester, 19 Mt. Pleasant (Ball); 3154 Steamboat Rock, 3143 Lansing, 3138 Mason City, 3351 Postville (Miss King); Winterset, Jewell Junction, Cedar Falls (Carver); 1132, Alden (Stevens); 3049, Pilot Mound (Miss King and MacCorkindale); Harcourt (Danielson); 2248, Quarry (Faurot); West Union, 1436 (Whitmore); Kossuth County, 791 (Pammel and Cratty); Amana, 704 (Schadt); 758, Dixon (Snyder); 682, Mt. Pleasant (Witte); 694, Glenwood (Jackson); 865, Emmet County (Pammel and Cratty); Birmingham, 845, 849 Libertyville (Baldwin); Benton County (Miss Sirrine); Sioux City (Miss Wakefield); Taylor County (Pool); Marshalltown (C. H. Eckles); Fayette (Fink); Lawler, Keokuk (P. H. Rolfs); Van Cleve (Warden); Iowa City (Hitchcock); Jewell Junction (J. A. Rolfs); Manly (Williams); Ames (Hitchcock, Beardslee, 146 Ball, Bessey, Fairfield, Kaufman, Ketterer, Crozier, F. Rolfs, Gossard and Rich); Newton (Misses Cavanagh and Dilne); Arnold's Park, Mason City, Jackson County, Beloit, Rock Rapids (Shimek); Twin Lake Township, Calhoun County (Preston); Decatur County (Fitzpatrick); Cedar Falls (Carver); Keystone (Koch); Iowa City (Shimek); Armstrong, 1071 (Cratty); Greenfield, Osceola (Stewart); Mt. Pleasant (Mills); Cedar Rapids (Miss Hall); Belmond (Clark); Algona (Watson); Nevada (Pammel); Traer (Provan); Slater (Fawcett and Tener); Eagle Grove (J. H. Buchanan); Pittsburg (Shimek); Oskaloosa (White).

North America. Maine, New Jersey (Deans Halsted), to Florida; west to Georgia, Alabama; Texas, north to Tennessee, Missouri, Wisconsin, (La Crosse Miss Pammel), Illinois, Nebraska, Kansas, to the Rocky Mountain region, Mexico; Guadalajara, and Pacific Coast; Nova Scotia to New Brunswick.

General. Common in Great Britain, on the continent of Europe in Germany, Denmark, France, to Asia, Africa, Australia, Mexico and South America.

2. *Panicum CRUS-GALLI* VAR. *MUTICUM*.

Panicum crus-galli L. var. *muticum* Vasey, Contr. U. S. Nat. Herb. 8: 37. 1892.



FIG. 87. *Panicum Crus-galli* var. *muticum* — a, spikelet; b, the same displayed showing glumes and awns. (Charlotte M. King.)

DESCRIPTION.

AWNLESS BARNYARD GRASS. An annual with culms 2 to 3 feet (6-9 dm.) high. Frequently branched at the base, sheaths smooth; leaves lightly hispid on both the upper and lower surfaces. Panicle dense, consisting of from 10 to 20 ascending branches. Spikelets ovate, greenish or purple, densely crowded. Glumes hispid without awns.

DISTRIBUTION.

Iowa. Iowa City, Ames (Hitchcock); Hawarden (Pammel); Iowa City (Macbride).

North America. About the same range as the species, from the Atlantic states along the Gulf coast, Great Lakes, but more common westward, Colorado, New Mexico, Utah and Arizona.

3. *Panicum WALTERI*.

Panicum Walteri Pursh. Fl. Am. Sept. 71. 26. Nash in Britton and Brown. Ill. Fl. 1: 113. f. 244. 1896. Scribner and Merrill. Rhodora 3: 127. *Panicum Crus-galli* var. *hispidum* Torr. Fl. N. Y. 2: 424. 1843. Watson and Coulter. Gray. Man. Bot. 734. 1890. (6 ed.) *P. hispidum* Muhl. Gram. 107. 1817. Beal. Grasses of N. A. 2: 119. 1896. *Panicum hirtellum* Walt. Fl. Car. 72: 1788.

DESCRIPTION.

SALT MARSH COCK-SPUR GRASS. Culms 3 to 6 feet (9-18 dm.) tall, robust, smooth. The lower sheaths usually papillose-hispid, smooth beneath or scabrous above. Panicles ample, 6-18 inches long, consisting of numerous ascending and spreading branches; spikelets ovate-lanceolate crowded in 2-4 rows on a hispid rachis. Greenish or brownish. Second and third glume scabrous and hispid, tipped with upwardly barbed awns. Fourth glume ovate-lanceolate, acuminate.

The *Panicum Crusgalli* is considered variable, but in none of its forms does it seem to

approach the *Panicum Walteri* of Pursh, and the latter may be regarded as a good species as Nash has done in Britton & Brown, Ill. Fl. 1: 113. f. 244.



FIG. 88. *Panicum Walteri*.—a, spikelet; b, flowering glume. (Charlotte M. King.)

DISTRIBUTION.

Iowa. West Union (Whitmore); Columbus Junction, 1512 (Pammel); Cedar Rapids (Hitchcock); Armstrong (Cratty); Marshalltown (Pammel); Iowa City (Hitchcock).

North America. Illinois (Indian Lake; Pammel), Ohio (Horr), Wisconsin (Parry). Also occurs in eastern and southern states, as far west as Texas.

4. *PANICUM FILIFORME*.

Panicum filiforme L. Sp. Pl. 57. 1753. Watson and Coulter, Gray Man. Bot. 630. 1890. (6 ed.). Scribner. Grasses of Tenn. Bull. Univ.

Tenn. Agr. Exp. Sta. 7: 39. f. 28. 1894. Scribner and Merrill, Rhodora, 8: 98. Beal. Grasses of N. A. 2: 109. 1896.

Paspalum filiforme Sw. Prodr. 22. 1788.

Syntherisma villosa Walt. Fl. Car. 77. 1788.

Syntherisma filiformis Nash. Bull. Torr. Bot. Club. 22: 420. 1895.

Syntherisma filiformis (L) Nash. Nash in Britton and Brown. Ill. Fl. 1: 111. f. 242. 1896.

- *Digitaria filiformis* Muhl. Gram. 131. 1817.

DESCRIPTION.



FIG. 89. *Panicum filiforme*.—a, Spikelets on rachis; b, c, d, e, parts of flowers displayed. (Charlotte M. King.)

SLENDER CRAB GRASS. A slender annual resembling crab grass somewhat in habit, but branching only near the base, less leafy, leaves usually erect, racemes less spreading and more slender, the axis being nearly filiform. Distinguished from *P. glabrum* at once by its more slender culms, pubescent or nearly hirsute lower leaf-sheaths, and more slender and less spreading racemes. The spikelets are also smaller, scarcely exceeding $\frac{3}{4}$ lines ($1\frac{1}{2}$ mm.) in length. In this species the first glume is usually wholly wanting. Dry sandy soil. July to September.

Panicum filiforme occurs chiefly in southeastern Iowa. Has been found on the sandy bluffs along Pine Creek, Muscatine County. It has been found once in Story County.

DISTRIBUTION.

Iowa. Wild Cat Den (Pammel); Muscatine (Reppert); Ames (Hitchcock).

North America. Common. Dry, sandy soil. Massachusetts to New Jersey, south to Florida (Simpson); west to Texas (College Station, Pammel), North Carolina (Vasey), Mexico (Palmer, 502), Missouri (St. Louis, Eggert; Jefferson, Eggert); Nebraska, Iowa and Michigan.

5. PANICUM GLABRUM.

Panicum glabrum Gaudin. Agrost. 1: 22. 1811. Watson and Coulter. Gray Man. Bot. 630. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 39. f. 27. 1894. Scribner and Merrill Rhodora. 3: 1002. Vasey Contr. U. S. Nat. Herb. 3: 24.

Panicum lineare Krock. F. Sil. 1: 95. 1787. Beal. Grasses of N. Am. 2: 110. 1896.

Panicum humifusum (Pers.) Kunth. Rev. Gram. 1: 33. 1835. Scribner. Am. Grasses. Bull. U. S. Dept. Agr. Div. Agros. 7: 43. f. 37. 1900. (3 ed.)

Syntherisma linearis Nash Bull. Torr. Bot. Club. 22: 420. 1895.

Syntherisma linearis (Krock) Nash in Britton and Brown. Ill. Fl. 1: 111. f. 241. 1896.

Syntherisma serotina Walt. Fl. Car. 76. 1788.

Syntherisma glabra. Schrad. Fl. Germ. 1: 163. 1806.

Paspalum ambiguum D. C. Fl. Gall. 123. 1806.

Digitaria humitusa Pers. Syn. 1: 85. 1805.

DESCRIPTION.

SMOOTH CRAB GRASS. An annual 6 inches to 2 feet (1½-6 dm.) high, closely resembling *P. sanguinale* in habit, but smooth throughout, excepting a few hairs at the throat of the sheaths. Spikelets two to seven, the spikelets are smaller, about 1 line (2 mm.) in length. First glume very minute or obsolete; second and third glumes nearly equal in length, or the second a little shorter than the fourth, pubescent of the back.

Smooth crab grass is common in eastern and central Iowa, especially in the flood plains of streams. It is also becoming common in lawns where it is a most troublesome weed.

DISTRIBUTION.

Iowa. Steamboat Rock, 3173 (Miss King); 37,724. Manchester (Ball); Greenfield (Stewart); Grand Junction (Thompson); Ames (Hitchcock, Beardslee); 2226 Ft. Dodge, 2252 Wilton Junction, Hawarden, Eagle Grove Sioux City Ledges, Boone County, 109 Dakota City, Clinton, Carnarvon, Turin, Carroll, 984 Des Moines, Marshalltown, Eagle Grove (Pammel); 783, Armstrong (Pammel and Cratty); Iowa City (Hitchcock); Keystone (Koch); 168, Ledges (Pammel and Ball); Fayette (Fink); Hampton (Hirshman); In-



FIG. 40. Crab grass (*Panicum sanguinale*), to the left; common in cultivated fields. To the right, *Panicum glabrum*, common in flood plains of rivers, and becoming common in lawns. a, leaf with sheath; b, spikelet; c, d, scales, stamens and pistil. (Charlotte M. King.)

dianola (Carver); Des Moines (Wallace); Newton (Misses Cavanagh and Dilne); Hamilton to Hancock County (Preston); Mason City (Pammel).

North America. From Nova Scotia to Ontario; New England south to Florida, New York (Penn Yan, Sartwell, Washington County, Parry); Missouri, Kansas, Nebraska, Iowa, Minnesota, Wisconsin, Michigan, Ohio (Columbus, Sullivan).

General. British Islands, Germany, France and eastward, generally in temperate and tropical regions.

6. PANICUM SANGUINALE.

Panicum sanguinale L. Sp. Pl. 57. 1753. Watson and Coulter. Gray. Man. Bot. 630. 1890. (6 ed.). Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 38. f. 26. 1894. Bull. U. S. Dept. Agr. Div. Agros. 17: 43. f. 339. 1899. Scribner and Merrill. Rhodora 3: 99. Vasey. Contr. U. S. Nat. Herb. 3: 25. Beal. Grasses of N. A. 2: 110. 1896.

Syntherisma sanguinalis (L.) Nash in Britton and Brown. Ill Fl. 1: 111. f. 240. 1896. Nash. Bull. Torr. Bot. Club. 22: 420. 1895.

Syntherisma praecox Walt. Fl. Car. 76. 1788.

Digitaria sanguinalis Scop. Fl. Carn. 1: 52. 1772. (2 ed.)

Paspalum sanguinale Lam. Tabl. Encycl. 1: 176. 1791.

DESCRIPTION.

CRAB GRASS OR FINGER GRASS. A much-branched, leafy annual, more or less decumbent at the base, and often rooting at the lower joints. Culms smooth, 1 to 3 or 4 feet ($\frac{1}{2}$ to 8 or 10 dm.) long, ascending; nodes smooth or sometimes bearded with deflexed hairs. Sheaths loose, smooth or pilose hairy, usually ciliate on the margins; ligule membranaceous, about 1 line (2 mm.) long; leaf-blade flaccid, 2 to 5 inches (4-10 cm.) long, 2 to 4 lines (4-8 mm.) wide, flat, acute, scabrous, sometimes sparingly pilose, and with the sheaths sometimes purple tinged. Racemes four to ten, digitate or subfasciculate at the apex of the culm, 3 to 5 inches (6-10 cm.) long, usually spreading. Spikelets about $1\frac{1}{2}$ lines (3 mm.) long, lanceolate, acute, in pairs, one nearly sessile, the other distinctly pedicellate; first glume very minute, the second one-half to two-thirds as long as the spikelet, usually ciliate on the margins and three-nerved; the third a little longer than the fourth, five-nerved, and usually silky-villous along the marginal nerves; fourth glume smooth, very acute. A weed in cultivated fields and lawns. June to September.

Crab grass is widely naturalized. It now occurs in all parts of the state. It is a troublesome weed in cultivated fields.

DISTRIBUTION.

Iowa. Ames (Zmunt, Hitchcock, C. A. Wilson, Beardslee, Fairfield, Ketterer, Kaufman, Reynolds, 163 Ball, Rich and Gossard); Mt. Pleasant, 1002 (Witte); Decatur County, Van Buren County (Fitzpatrick); Belknap, 820 (Rankin); Glenwood, 996 (Jackson); Decorah, 3188 (Jacobson); Lansing, 3160, 3042 Steamboat Rock (Miss King); Manchester, 713 (Ball); Chariton, 1000 (Mallory); Mt. Ayr, 637 (Beard); Amana, 700 (Schadt); Dixon, 726 (Snyder); Creston, 794 (Bettenga); Montrose, 805 (Osborn); Waukon, 813 (Beeman); Des Moines, Ledges (Boone County), Clinton, Ames, Council Bluffs, Des Moines, 650, 1456 De Witt (Pammel); Dysart (Miss Sirrine); Marshalltown (Stewart); Keokuk (Rolf); Boone (Carver); Van Cleve (Warden); Cedar Rapids (Miss Hall); LeClaire (Rolf); Armstrong 1050 (Cratty); Hamilton to Hancock County (Preston).

North America. From New England, New Jersey (Milltown, Halsted, 98), Connecticut (Glastonbury, Francis Wilson, 1247), Maryland (Crisfield, Holm), North Carolina (Dun's Mt., Small), Kentucky (Harlan County, Kearney), Ohio (Pickerington, Horr), south to Florida, west to Texas (Calvert, Pammel), and Mexico; Rocky Mountain region, Kansas, Nebraska, the Dakotas, Minnesota, Iowa, Wisconsin (LaCrosse, Pammel), Illinois (Indian Lake, Pammel), Missouri (St. Louis, Pammel), (St. Louis, Eggert), (Jefferson Barracks, Pammel), Colorado (Denver, Pammel, Johnson and Lummis, 899).

General. British Islands, across the continent, in temperate and subtropical countries.

7. PANICUM CAPILLARE.

Panicum capillare L. Sp. Pl. 58. 1753. Watson and Coulter in Gray. Man. of Bot. 630. 1890. (6 ed.). Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 43. f. 37. 1894. Bull. U. S. Dept. Agr. Div. Agros. 17: 54. f. 350. 1896. Scribner and Merrill. Rhodora 3: 105. Vasey. Contr. U. S. Nat. Herb. 3: 33. Beal. Grasses of N. A. 2: 129. 1896. Nash in Britton and Brown. Ill. Fl. 1: 123. f. 274. 1896.

DESCRIPTION.

OLD WITCH GRASS, TUMBLE GRASS. An annual with usually coarse, branching stems, 1 to 3 feet (2-6 dm.) long, with very hairy leaf-sheaths and capillary, widely spreading panicles, terminal on the culm or its branches. Culm geniculate and branching near the base, rarely simple, generally pilose or pubescent below the bearded nodes. Sheaths pilose to densely hirsute, with spreading hairs; ligule very short, densely ciliate; leaf-blade flat, lanceolate or linear, acute, usually thinly hairy on both sides, margins scabrous and ciliate near the base. The

hairs throughout spring from small papillae, those on the leaf-blade being confined chiefly to the principal nerves. Panicle diffuse, 3 to 12 inches (6-24 cm.) long, the branches solitary, in pairs, or rarely whorled, the ultimate branches and pedicels strongly hispid. Spikelets 1 line (2 mm.)



FIG. 41. *Panicum capillare*.—a, b, and c, spikelets; d, e, flowering glume.

long, ovate, acute, or abruptly acuminate-pointed, smooth; first glume clasping the base of the spikelet, obtuse or acute, one to three-nerved, about one-third the length of the five to seven-nerved and nearly equal second and third glumes, the acute tips of these are sometimes minutely pubescent; flowering glume smooth and shining, elliptical, obtuse, or subacute, a little shorter than the larger outer glumes. Variable. July to October.

Old witch grass is common throughout the state, frequently as a weed. It is variable. The forms occurring in cultivated fields are stout and hispid. When occurring in moist meadows and old lake beds it has slender and somewhat capillary branches.

DISTRIBUTION.

Iowa. Plymouth County, Woodbury County (Brown); Montrose, 766 (Osborn); Harcourt (Danielson); Muscatine, 508 (Reppert); Fayette (Fink); Dallas Center, 815 (Rhinehart); Decatur County (Fitzpatrick); Wild Cat Den, 1301 (Pammel and Reppert); Belknap (Rankin); Keokuk (P. H. Rolfs); Alden, 1127 (Stevens); Manchester, 720 (Ball); Garwin (Crawford); Greenfield (Stewart); 1104, Winterset, Gilbert, Jewell Junction (Carver); Charles City (Anderson); Emmet County, 850 (Pammel and Cratty); 3155 and 3051 Steamboat Rock, 3004 and 3141 Lansing (Miss King); West Union (Whitmore); 3229 Boone, Dakota City, 1081 Marshalltown, Eagle Grove, 767 Ledyard, Turin Carroll, Clinton, Logan, 874 Elmore, South Dakota, opposite Hawarden, Cedar Rapids, Ledges, Boone County, 290 Sioux City, Carnavon (Pammel); Ames (Sirriner, Zmunt, Hitchcock, Kaufman, Ball, Pammel, Bessey, 691 Wadleigh), 120 Ball; Fairfield (Miss Wood, Ketterer, Reynolds); Maquoketa (Goodenow); 19 Granite, Spirit Lake (Shimek); Creston (Bettenga); 739, Dixon (Snyder); Mt. Ayr, 648 (Beard); 998, Glenwood (Jackson); Sioux City (Wakefield); Lawler (P. H. Rolfs); Mt. Pleasant, 681 (Witte); Marshalltown (R. B. Eckles); Jewell Junction (J. A. Rolfs); Council Bluffs (Misses Cavanagh and Dilne); Spirit Lake (Shimek); Hamilton to Hancock County (Preston); Algona (Watson); Traer (Provan); Ledges (Buchanan); Slater (Fawcett and Tener); Oskaloosa (White).

North America. From Maine, Connecticut (Hartford, Wilson), New Jersey (Halsted, 96), south to Florida; west to Texas, Arkansas and Alabama. Wisconsin (LaCrosse, L. H. Pammel, Dora Pammel and C. M. King), Indiana (Pammel), Illinois (Chicago, Pammel, Egger), Minnesota (Sandberg), Missouri (Meramec, Pammel).

Europe. Introduced in southern Europe and Russia.

8. PANICUM MINIMUM.

Panicum minimum Scrib. and Merr. Cir. U. S. Dept. Agr. Div. Agros. 27: 4. 1900.

Panicum minimum Scrib. and Merr. Rhodora 3: 105. 1905.

Panicum capillare minimum Engel. Scrib. Bul. Tenn. Agr. Exp. Sta. 7: 44. f. 40. 1894.

DESCRIPTION.

SMALL TUMBLE GRASS. A slender annual, rarely more than 1½ feet (3 dm.) high, with long-pilose sheaths, narrow, flat leaves, and oval or pyramidal, few-flowered panicles 4 to 8 inches (8-16 cm.) long. Leaves 2½ to 5 inches (5-10 cm.) long, 1 to 3 inches (2-6 cm.)

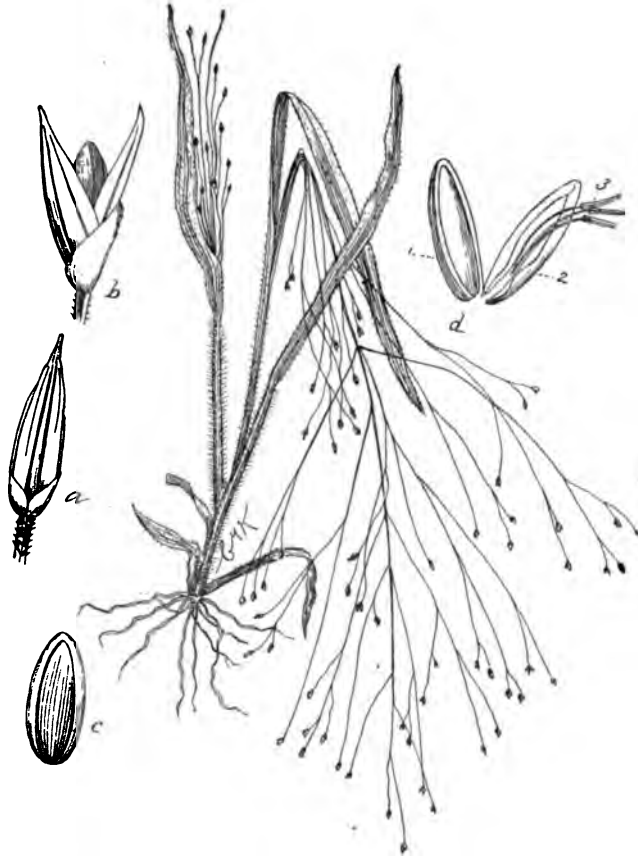


FIG. 2. *Panicum minimum*.—a, b, spikelets; c, d, flower. (Charlotte M. King.)

wide, erect, more or less pubescent. Panicles open, the lower branches 2½ to 3 inches (5-7 cm.) long, spreading or ascending. Spikelets about 3.5 inches (1.5 mm.) long, elliptic, acute, smooth, usually borne in pairs at the extremities of the ultimate branches of the panicle; first glume about one-third as long as the equal, acute, second and third ones; flowering glume somewhat shorter than the third.

DISTRIBUTION.

Iowa. Slater (Fawcett and Tener); High Bridge (Lummis).
Missouri to Iowa.

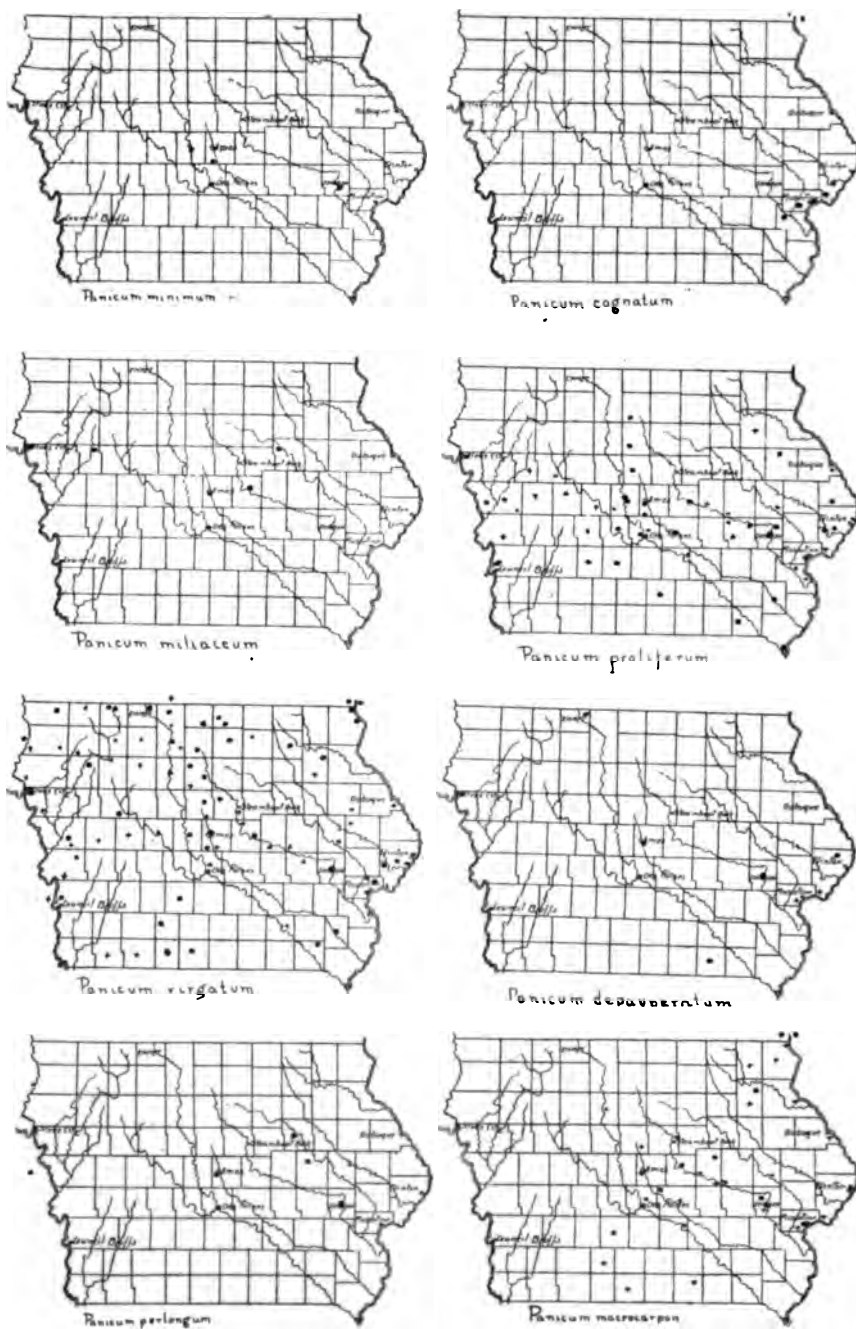


FIG. 48. Distribution of species of *Panicum*. + From observation. • In Herbarium.

9. PANICUM COGNATUM.

Panicum cognatum Schultes Mant. 2: 235. 1824. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 51. f. 347. 1899.

Panicum autumnale Bosc. Spreng. Syst. 1: 320. 1825. Watson and Coulter. Gray. Man. Bot. 630. 1890. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 44. 1894. Beal. Grasses of N. A. 2: 122. 1896. Vasey Contr. U. S. Nat. Herb. 3: 33. Nash in Britton and Brown, Ill. Fl. 1: 124. f. 34. 1896.

Panicum divergens Muhl. Gram. 170. 1817.

DESCRIPTION.

DIFFUSE PURPLE PANICUM. Perennial with erect or decumbent culms, 1 to 2 feet (2½-5 cm.) high, generally much branched at base, slender. Sheaths shorter than the internodes, the upper glabrous, the lower sometimes densely pubescent; leaves 1½ to 4 inches (3-8 cm.) long, 1 to 3 lines (2-6 mm.) wide, ascending, acuminate, glabrous; panicle 5 to 12 inches (10-24 cm.) long, bearded in the axils, the lower branches 4 to 8 inches (9-16 cm.) long, at first erect with the lower portions included in the upper sheath, finally exserted and widely spreading at maturity; spikelets lanceolate, about 1½ lines (3 mm.) long, acuminate, glabrous or pubescent, on capillary pedicels, of many times their length; first scale minute; second and third, equal. Acute, glabrous or sometimes villous, the fourth lanceolate, 1¼ line (2 mm.) long.



Panicum cognatum.—a, b, c, spikelets; d, e, flowering glumes. (Div. Agros. U. S. Dept. Agr.)

Panicum cognatum has been found in eastern Iowa only on sandy beaches of the Mississippi, Iowa and Cedar rivers. It is abundant on

Muscatine Island, and occurs in isolated places as far north as LaCrosse County, Wisconsin, and Houston County, Minnesota.

DISTRIBUTION.

Iowa. Scott and Muscatine Counties (Barnes and Miller); Muscatine, 1237 (Reppert); Columbus Junction, 1506 (Pammel).

North America. In sandy soil from South Carolina (A. H. Curtiss), Georgia, Florida; west to Minnesota, Iowa, Missouri (Carson Station, Eggert), Kansas and Texas.

10. PANICUM MILIACEUM.

Panicum miliaceum L. Sp. Pl. 58. 1753. Beal. Grasses of N. A. 2: 125. 1896. Vasey Contr. U. S. Nat. Herb 3: 34. Nash in Britton and Brown. Ill. Fl. 1: 123 f. 272. 1896. Scribner and Merrill. Rhodora 3: 106.

DESCRIPTION.

MILLET. An annual with erect or decumbent culms, rather stout 1 foot ($2\frac{1}{2}$ dm.) tall, glabrous or hirsute. Sheaths papillose-hirsute, leaves 5 to 10 inches (10-20 cm.) long, $\frac{1}{3}$ to 1 inch ($\frac{2}{3}$ -2 cm.) wide, more or less pubescent; panicle rather dense, 4 to 10 inches (8-20 cm.) long; branches erect or ascending; spikelets 2 to $2\frac{1}{2}$ lines (4-5 mm.) long, acuminate; first scale about two-thirds as long as the spikelet, acuminate, five to seven-nerved; second scale 2 to $2\frac{1}{2}$ lines (4-5 mm.) long, acuminate, thirteen-nerved somewhat exceeding the seven to thirteen nerved, acuminate third one, which subtends an empty palea; fourth scale shorter than the third, becoming indurated, obtuse. In waste places. July to September.



FIG. 45. *Panicum miliaceum*.—a, Spikelet, showing first and third glumes; b, spikelet, showing dorsal surface of the second glume; c, anterior view of third glume, showing the small palea; d, dorsal view of fourth glume; e, anterior view of the same, showing the palea. (Div. of Agric. U. S. Dept. of Agri.)

Millet is cultivated chiefly in northwestern Iowa. It is an excellent annual grass.

DISTRIBUTION.

Iowa. Albion (Wheeler); Ames (Crozier); Sioux City (Miss Wakefield); Galva (Conger and Crowley); Ames (Ball); Cedar Rapids (Miss Hall).

North America. Maine to New York, New Jersey, Pennsylvania, and occasionally in the northwestern states, Iowa, Minnesota and the Dakotas.

General. Cultivated since pre-historic times. It is not known in a wild state. Perhaps indigenous to the East Indies; extensively cultivated in China and Japan and the East Indies and occasionally in southern Russia.

11. PANICUM PROLIFERUM.

Panicum proliferum Lam. Encyc. 4: 747. 1797. Watson and Coulter. Gray. Man. Bot. 630. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull Univ. Tenn. Agr. Exp. Sta. 7: 43. f. 36. 1894. Am. Grasses. Bull. U. S. Dept. Agr. Div. Agros. 7: 57. f. 51. 1900. (3 ed.) Scribner and Merrill. Rhodora 3: 104. Vasey Contr. U. S. Nat. Herb. 3: 34. Beal. Grasses of N. A. 2: 129. 1896. Nash in Britton and Brown. Ill. Fl. 1: 123. f. 273. 1896.

Panicum geniculatum Muhl. Gram. 123. 1817.

DESCRIPTION.

SPROUTING CRAB GRASS.

A smooth, usually much branched annual, with stems 2 to 4 or 6 feet, rather coarse, spreading or ascending (rarely erect) (5-10 or 14 dm.) long, flat leaves and diffuse terminal and lateral panicles. Sheaths smooth, lax, somewhat flattened; ligule ciliate; leaf-blade 6 to 12 or 24 inches (12-24 or 48 cm.) long, 2 to 10 lines (4-20 mm.) wide, acute, scabrous on the margins and sometimes also on the prominent nerves, rarely pilose on the upper surface; panicles pyramidal, 4 or 5 to 12 or 15 inches (8 or 10-24 or 30 cm.) long, the primary and secondary branches spreading, scabrous. Spikelets rather crowded upon short, appressed and scabrous pedi-



FIG. 46. *Panicum proliferum*.—a, b, c, spikelets; d, e, flowering glume. (Div. of Agros. U. S. Dept. of Agrl.)

cels, lanceolate ovate, acute, 1 to $1\frac{1}{2}$ lines (2-3 mm.) long, smooth, green or purplish; lowest glume embracing the base of the spikelet, usually obtuse and nerveless, rarely one to three-nerved, one-fourth to one-third as long as the nearly acute five to seven-nerved second and third

glumes, the latter having sometimes a hyaline palea in its axil; floral glume elliptical, subacute, smooth and shining, a little shorter than the larger outer glumes. Anthers saffron yellow. Sprouting crab grass is widely naturalized in many parts of the state, appearing along railroads, roadsides and in streets. March to October.

DISTRIBUTION.

Iowa. Keokuk (Rolfs); Boone, 3203 (Pammel); Boone Viaduct, 3288 (Pammel); De Witt, 1453 (Pammel); Indianola, Winterset (Carver); Dixon, 730 (Snyder); Des Moines, 649 (Pammel); Chariton, 677 (Mallory); Amana, 696 (Schadt); Manchester, 1030 (Ball); Maquoketa (Goodenow); Onawa, Carroll, Des Moines, Clinton (Pammel); Dallas Center, 816 (Rhinehart); Greenfield, Marshalltown (Stewart); Ames (Hitchcock, Bessey, Serrine); Manchester, 39 (Ball); Sioux City (Wakefield); Mt. Pleasant (Mills); Lebanon, 35 (Ball and Sample); Newton (Misses Cavanaugh and Dilne); Johnson County (Shimek); Hamilton to Hancock County (Preston); Iowa City (Macbride, Shimek, Hitchcock); Slater (Fawcett and Tener); Eagle Grove (J. H. Buchanan).

North America. Maine to Maryland; Virginia (Portsmouth, Noyes), District of Columbia (Washington, Vasey), Ohio (Columbus, Sullivant), Florida (Lake City, Combs), west to Alabama, Tennessee and Mississippi (Tracy), north to Missouri (St. Louis, Pammel; Wickes, Pammel; Jefferson, Eggert), Kansas, Nebraska, Iowa, Wisconsin and Illinois (St. Clair County, Eggert).

12. PANICUM VIRGATUM.

Panicum virgatum L. Sp. Pl. 59. 1753. Watson and Coulter. Gray. Man. of Bot. 631. 1690. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 42. f. 35. 1894. Scribner. Am. Grasses. Bull. U. S. Dept. Agr. Div. Agros. 7: 60. f. 54. 1900. (3 ed.) Scribner and Merrill Rhodora 3: 103. Vasey Contr. U. S. Nat. Herb. 3: 36. Beal. Grasses of N. A. 2: 123. 1896. Nash in Britton and Brown, Ill. Fl. 1: 122. f. 273. 1896.

DESCRIPTION.



FIG. 47. *Panicum virgatum*—a, spikelet; b, second and third glumes; c, d, flowering glume. (Div. of Agros. U. S. Dept. of Agri.)

SWITCH GRASS. A stout, erect perennial, 3 to 5 feet (7-12 dm.) high, with strong creeping root stocks, long, flat leaves and ample spreading panicle. Culms smooth, terete. Sheaths smooth, ciliate along the margins above; ligule very short, naked, or densely and long pilose; leaf-blade 10 to 24 inches (20-48 cm.) long, 2 to 5 lines (4-10 mm.) wide, scabrous on the margins, sometimes pilose near the base, otherwise smooth, long-acuminate pointed. Panicles 6 to 20 inches (12-40 cm.) long; the branches solitary, or several together, more or less widely spreading, rather rigid, the lower 4 to 10 inches (8-20 cm.) long. Spikelets ovate, acuminate, 2 to 2½ lines (2-5 mm.) long; the acuminate first glume about one-half the length of the spikelet, three to five-nerved; second glume

usually longer than the others, five to seven-nerved, as is the third, which has a palea and usually a staminate flower in it; axil; flowering glume smooth and shining, distinctly shorter than the larger outer glumes. Sandy soil, usually along streams, prairies and about ponds and lakes. July to October. A common grass on the prairies in Iowa, Nebraska and Minnesota.

DISTRIBUTION.

Iowa. Lansing, 3003, 3159 (Miss King); Winterset (Carver); Mt. Pleasant, 770 (Mills); Alden, 1130 (Stevens); Mt. Ayr, 640 (Beard); Dixon, 652 (Snyder); Marshalltown (Stewart); Cherokee County (Crozier); Forest City, 41 (Shimek); Kossuth County, 810 (Cratty); Kossuth County, 792 (Pammel and Cratty); Turin, 2250, Wilton Junction, Carnarvon, Hawarden, New Albin, 936, Marshalltown, Eagle Grove, Boone, De Witt, 1458, Clinton, Dakota City (Pammel); Ames (P. H. Rolfs, Bessey, Hitchcock, 690, Wadleigh, C. A. Wilson, 176, Ball, Gossard and Rich); Okoboji, 11, Spirit Lake (Shimek); Sioux City (Miss Wakefield, Shimek); Slater, 878 (Pammel); Creston (Bettenga); Lawler (P. H. Rolfs); Emmet County, 1066 (Cratty); Muscatine, 515 (Reppert); Wilsonville (Taylor); Rock Rapids, 31 (Shimek); Manly (Williams); Fayette (Fink); Sioux City (Miss Wakefield); Decatur County, Muscatine County (Fitzpatrick); Camanche (Ball); Spirit Lake (Shimek); Iowa City (Miss Linder); Hamilton to Hancock County (Preston); Muscatine County (Fitzpatrick and Bartsch); Armstrong (Cratty); Rock Rapids (Shimek); Mason City (Pammel); Algona (Watson).

North America. Maine to Massachusetts, New York to Florida (Duvall County, Curtiss), (Braidentown, Combs); Alabama, Tennessee, Mississippi (Jefferson County, Eggert), Arkansas (Ft. Smith, Rolfs), Texas (Mellisa, Denison, Pammel), to Arizona and Mexico; Colorado (northern Colorado, Fry), (La Porte, Pammel and Johnson), (Larimer County, Pammel), Nebraska (McCook, Pammel, 369, 390), the Dakotas (Redfield, Griffith), Minnesota (Sand Lake, Sandberg; St. Croix, Parry), Wisconsin (Parry, LaCrosse, D. S. Pammel and Edna Pammel, 3313; L. H. Pammel), Missouri (Jefferson Barracks, Eggert), Ohio (Painesville, Beardslee; Columbus Sullivant).

13. PANICUM DEPAUPERATUM.

Panicum depauperatum Muhl. Gram. 112. 1817. Watson and Coulter. Gray. Man. Bot. 633. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 49. f. 49. 1894. Bull. U. S. Dept. Agrl. Div. Agros. 17: 89. f. 385. 1899. Scribner and Merrill. Rhodora 3: 107. Vasey Contr. U. S. Nat. Herb. 3: 29. Beal. Grasses of N. A. 2: 140. 1895. Nash in Britton and Brown. Ill. Fl. 1: 121. f. 268. 1896

DESCRIPTION.



FIG. 43. *Panicum depauperatum*—a, b, c, spikelets; d, palea; e, f, flowering glumes. (Div. of Agros. U. S. Dept. of Agri.)

STARVED PANICUM. Densely caespitose, with slender culms 6 to 18 inches (12-36 cm.) high, and very narrow, long, erect leaves. Culms simple or finally branched near the base, the branches flower bearing; nodes usually bearded. Sheaths smooth or more or less densely pilose, with soft spreading hairs; ligule a fringe of short hairs; leaf-blade 1 to 2 lines (2-4 mm.) wide, 3 to 8 inches (6-16 cm.) long, very acute, often involute, at least when dry, scabrous and sometimes pilose, at least near the base. Panicle 1 to 4 inches (2-8 cm.) long, nearly simple, loosely few-flowered, the solitary branches ascending or erect and scabrous. Spikelets 1 to 2 lines (2-4 mm.) long, usually $1\frac{1}{2}$ lines (3 mm.), ovate, acutish, smooth; first glume about one-fourth the length of the second and third, which are prominently 7 to 9-nerved and acute, the third with a small thin palea, fourth glume smooth rounded-

obtus, a little shorter than the second and third. Open woodlands and gravelly fields. May to August.

DISTRIBUTION.

Iowa. Clinton County (Butler); Sioux City (Hitchcock); Ames (Bessey, Carver, Hitchcock); Armstrong, 1058 (Cratty); Bloomfield, 2138 (Pammel); Iowa City (Hitchcock and Macbride).

North America. From Nova Scotia to Manitoba; Atlantic states south to Florida, Alabama and Texas (Nealley); Iowa, Minnesota and Nebraska.

14. PANICUM PERLONGUM.

Panicum perlongum. Nash in Britton Man. 1040. 1901.

DESCRIPTION.

SLENDER PANIC GRASS. A slender, caespitose, hairy perennial, $\frac{1}{2}$ to $1\frac{1}{2}$ feet (2-4 dm.) high, hirsute sheaths with long, linear, erect papillose-hispid leaves, simple, open, exserted panicles 2 to 4 inches (4-6 cm.) long, extending beyond the upper leaf. Lower panicles short, spikelets about 1.5 lines (3.25 mm.) long and less than 1 line (1.5-1.75 mm.) wide, pubescent with a few scattered long hairs. Prairies and dry soil. May to August.

DISTRIBUTION.

Iowa. Iowa City (Hitchcock); Vinton (Davis); Ames, 145 (Ball), cited in original description. Regarded as *P. depauperatum* by Ashe; Waterloo (Hitchcock).

North America. Illinois, Iowa, to South Dakota, south to Indian Territory.

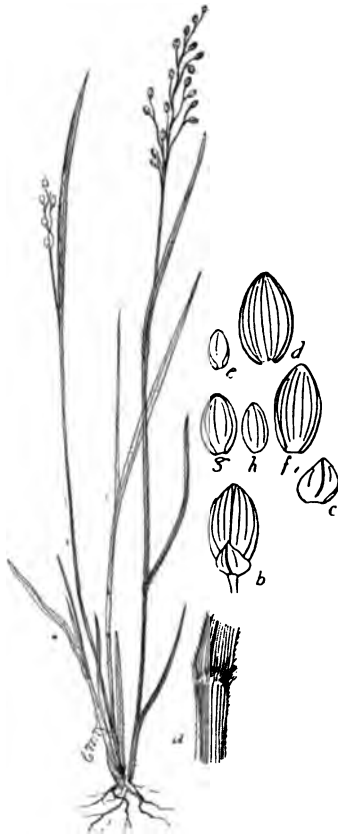


FIG. 43. *Panicum perlongum*.—a, Part of node showing sheath and ligule; b, spikelet; c, e, parts of spikelets displayed. (Charlotte M. King.)

15. PANICUM LINEARIFOLIUM.

Panicum linearifolium Scribn. Bull. U. S. Dept. Agr. Div. Agros. 11: pl. 1. 1898. Britton and Brown Ill. Fl. 3: 500. f. 268. A. Scribner and Merrill. Rhodora 3: 108.

Panicum enslini Trin. Man. Nees. Agros. Bras. 2: 227. 1829. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 88. f. 384. 1899.

Panicum depauperatum var. *laxa*. Vasey Bull. Div. Bot. U. S. Dept. Agr. 8: 29.

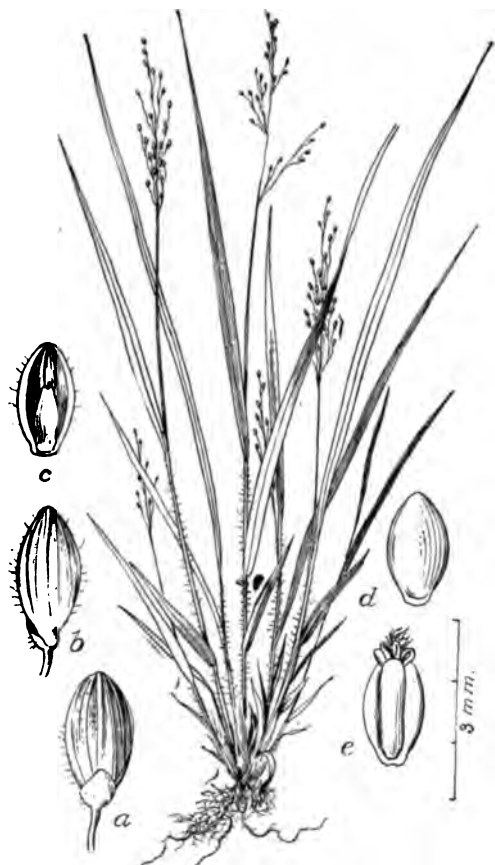


FIG. 50. *Panicum linearifolium*. —a, b, Spikelet; c, d, e, details of flower. (Div. of Agros. U. S. Dept. of Agr.)

DESCRIPTION.

LINEAR-LEAVED PANICUM. A slender, erect, densely caespitose perennial $\frac{1}{2}$ to $1\frac{1}{2}$ feet (2-4 dm.) high, with long, linear-lanceolate, erect leaves and simple, open panicles $2\frac{1}{2}$ to 4 inches (5-8 cm.) long. Spikelets 1 to $1\frac{1}{2}$ lines ($2-2\frac{1}{2}$ mm.) long, obovate, obtuse, with the 7-nerved second and third glumes glabrous or sparingly pilose. Dry soils, hillsides.

DISTRIBUTION.

Iowa. Sioux City (A. S. Hitchcock).

North America. From New England and Virginia west to Iowa, Missouri and Texas.

16. PANICUM XANTHOPHYSUM.

Panicum xanthophysum A. Gray. Ann. Lyc. N. Y. 3: 233. 1835. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 103. f. 599. 1899. Britton and Brown. Ill. Fl. 1: 118. f. 258. Scribner and Merrill. Rhodora. 3: 108. Vasey. Contr. U. S. Nat. Herb. 3: 29. Watson and Coulter. Gray's Man. 431. (6 ed.)

DESCRIPTION.

SLENDER PANICUM. A slender, or occasionally rather stout, erect perennial, 1 to 2 feet (3-6 dm.) high, sparingly branched near the base, with broadly lanceolate leaves 2 to 6 inches (6-15 cm.) long, and simple, rather few-flowered, racemose panicles 1 to 3 inches (3-8 cm.)

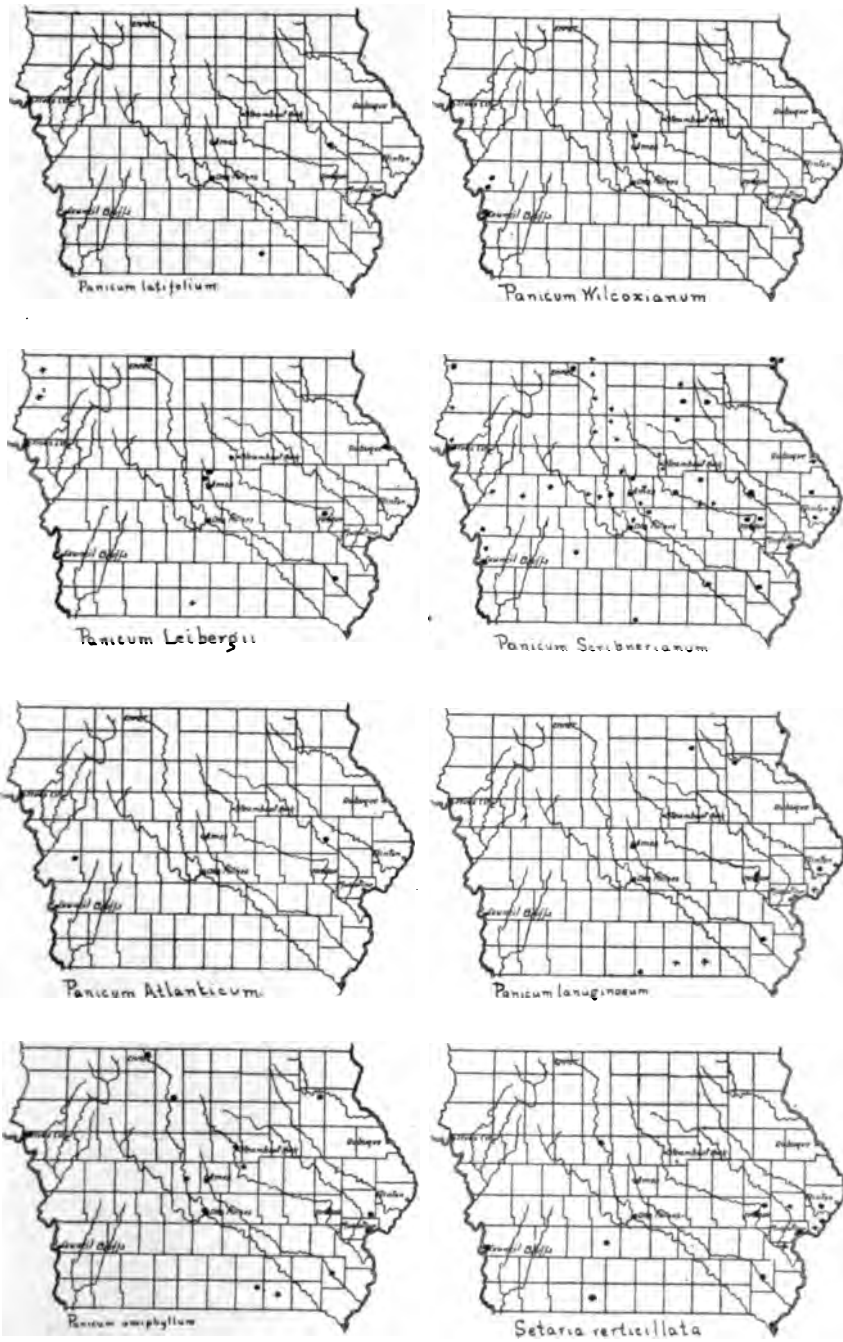


FIG. 51. Distribution of species of *Panicum*. + From observation. • Herbarium.

long. Spikelets obovoid, obtuse, about 1.5 line (3 mm.) long, the second and third glumes pubescent. Dry, sandy soil. June to September.

DISTRIBUTION.

Iowa. The species has not been found in the state, although recorded in Gray's Manual and Britton and Brown's Illustrated Flora.

North America. In dry soil, Quebec to Pennsylvania, west to Minnesota and Manitoba.

17. PANICUM MACROCARPON.

Panicum macrocarpon Le Conte. Torr. Cat. 91. 1819. Nash. in Britton and Brown. Ill. Fl. 1: 117. f. 256. Scribner and Merrill. Rhodora. 3: 111. Most of the Iowa material has usually been referred to *P. latifolium* Walt.



FIG. 52.
Panicum zanthophyllum.
(Charlotte M. King.)

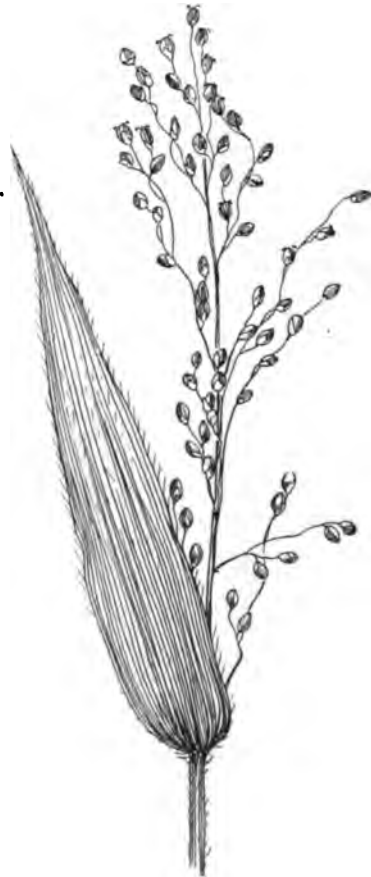


FIG. 53.
Panicum macrocarpon.
(Charlotte M. King.)

DESCRIPTION.

LARGE FRUITED PANICUM. A stout, glabrous perennial, culms smooth, branched above, 1 to 2½ feet (3-10 dm.) high, with broad lanceolate leaves; leaf blade 2 to 5 inches (5-17 cm.) long, 1 to 1½ inches (2-4 cm.) wide, cordate, clasping at the base, long acuminate, glabrous on both sides or with a few scattered strigose hairs, usually ciliate on the serrulate scabrous margins, especially near the base; sheaths glabrous or sparingly pubescent, generally somewhat ciliate on the margins, shorter than the internodes; ligule very short; few open flowered panicles, 2 to 4 inches (5-15 cm.) long; rachis glabrous, branches alternate, compound, glabrous, spreading erect; spikelets 1½ to 2 inches (3-4 cm.) long, oval to obovate; first glume one-third to one-half as long as the spikelet, acute or obtuse; second and third glumes pubescent, turgid, 9-11 nerved; flowering glumes 1¼ to 1½ lines (2.5-3 mm.) long, minutely pubescent at the apex. Moist places. July to August.

There are intergrading forms between *P. macrocarpon* and *P. latifolium*. The *P. latifolium* is east of our range generally, but it may be looked for in the eastern half of the state.

DISTRIBUTION.

Iowa. Ames (Carver); Ames (Ball and Sample, Hitchcock, 155 Ball, Bessey, Beardslee); Iowa City (Hitchcock); Clermont, 2048, 2178 (Walker); Johnson County, 3 (Miss Linder, Shimek); Muscatine, 501 (Reppert); Winterset (Carver); Dysart (Miss Sirrine); Colfax (Mead); Albin (Wheeler), Creston (Andrews).

North America. Maine, New Jersey, New York (Washington County, Parry), District of Columbia (Hamilton Hill, Washington; Ball), North Carolina (Duns Mt., Small), (Boynton) Florida; west to Alabama and eastern Tennessee; north to Missouri (St. Louis, Eggert; Allenton, Pammel), Iowa, Wisconsin, Minnesota to Quebec and Ontario.

18. PANICUM LATIFOLIUM.

Panicum latifolium L. Sp. Pl. 58. 1753 (1 ed.) Watson and Coulter, Gray Man. 632. 1889. (6 ed.) Walt. Fl. Car. 73. 1788. Scribner. Bull. U. S. Dept. Agri. Div. Agros. 17: 100. f. 396 Scribner and Merrill. Rhodora. 3: 111. Vasey Contr. U. S. Nat. Herb. 3: 33.

Panicum Porterianum Nash. in Britton and Brown. Ill. Fl. 1: 117. f. 254. 1896. Bull. Torr. Bot. Club. 22: 420. 1895.

Panicum Walteri Poir. in Lam. Encycl. Suppl. 4: 282. 1816. Scribner Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 47. f. 45.



FIG. 54. *Panicum latifolium*—a, b, c, spikelets. (Div. of Agros. U. S. Dept. Agrl.)

DESCRIPTION.

PORTER'S PANICUM. A rather slender, branching perennial, 1 to 2 feet (3 to 6 dm.) high, with broad, ovate-lanceolate leaves, and few-flowered, nearly simple panicles. Spikelets ovate-elliptical or pear-shaped, obtuse, about 2 lines (4 mm.) long, outer glumes shortly pubescent. Common in open woodlands and thickets. May to October.

DISTRIBUTION.

Iowa. Cedar Rapids (Hitchcock); Unionville (Shimek).

North America. Maine, Ontario to Minnesota southward to Florida and Texas.

19 PANICUM WILCOXIANUM.

Panicum Wilcoxianum Vasey. Bull. Div. Bot. U. S. Dept. Agrl. 8: 32. 1889. Scribner. U. S. Dept. Agrl. Div. Agros. 17: 95. f. 391. Britton and Brown. Ill. Fl. 1: 119. f. 260.

DESCRIPTION.

WILCOX'S PANICUM. An erect, sparingly branched perennial 5 to 11 inches (1.2-2.8 dm.) high, papillate hairy sheaths, ligule a ring of hairs; long acuminate leaves $1\frac{1}{2}$ to 3 inches (4-7 cm.) long, pubescent with long hairs, margins rough. Panicle 1 to $1\frac{1}{2}$ inches (2.5-4 cm.) long, usually compact, spreading or ascending, spikelets $1\frac{1}{4}$ lines (2.5 mm.) long. Lower scale with broad base about one-third as long as the spikelet, pubescent, second and third nearly equal, pubescent. Dry soil. May to August.

DISTRIBUTION.

Iowa. Council Bluffs, 1285 (Pammel), Missouri Valley, 3198 (Pammel), Gilbert Station (Carver).

North America. Kansas northward through Nebraska, central and western Iowa, Dakotas and Manitoba.



FIG. 55. *Panicum Wilcoxianum*—a, spikelets; b, c, stamens and pistil of flower. (Charlotte M. King.)

20. PANICUM LEIBERGII.

Panicum Leibergii Scribn. In Vasey. Bull. U. S. Dept. Agr. Div. Bot 8: 32. Scribn. Bull. U. S. Dept. Agr. Div. Agros. 17: 101. f. 397. 1899. Nash in Britton and Brown. Ill. Fl 3: 497. f. 259. 1896.

Panicum scoparium var. *Leibergii* Vasey. Contr. U. S. Nat. Herb. 3: 31.

DESCRIPTION.

LEIBERG'S PANICUM. A slender, ascending, perennial grass, $1\frac{1}{2}$ to 3 feet (3-6 dm.) high, with rather broad, flat leaves and few-flowered panicles of comparatively large, obtuse, spikelets, $1\frac{1}{2}$ to 2 lines (3-4 mm.) long, the outer glumes papillate-pilose with stiff, spreading hairs. May to July.

Panicum Leibergii is common in meadows of central and northern Iowa. First found by J. B. Leiberg in northwestern Iowa.

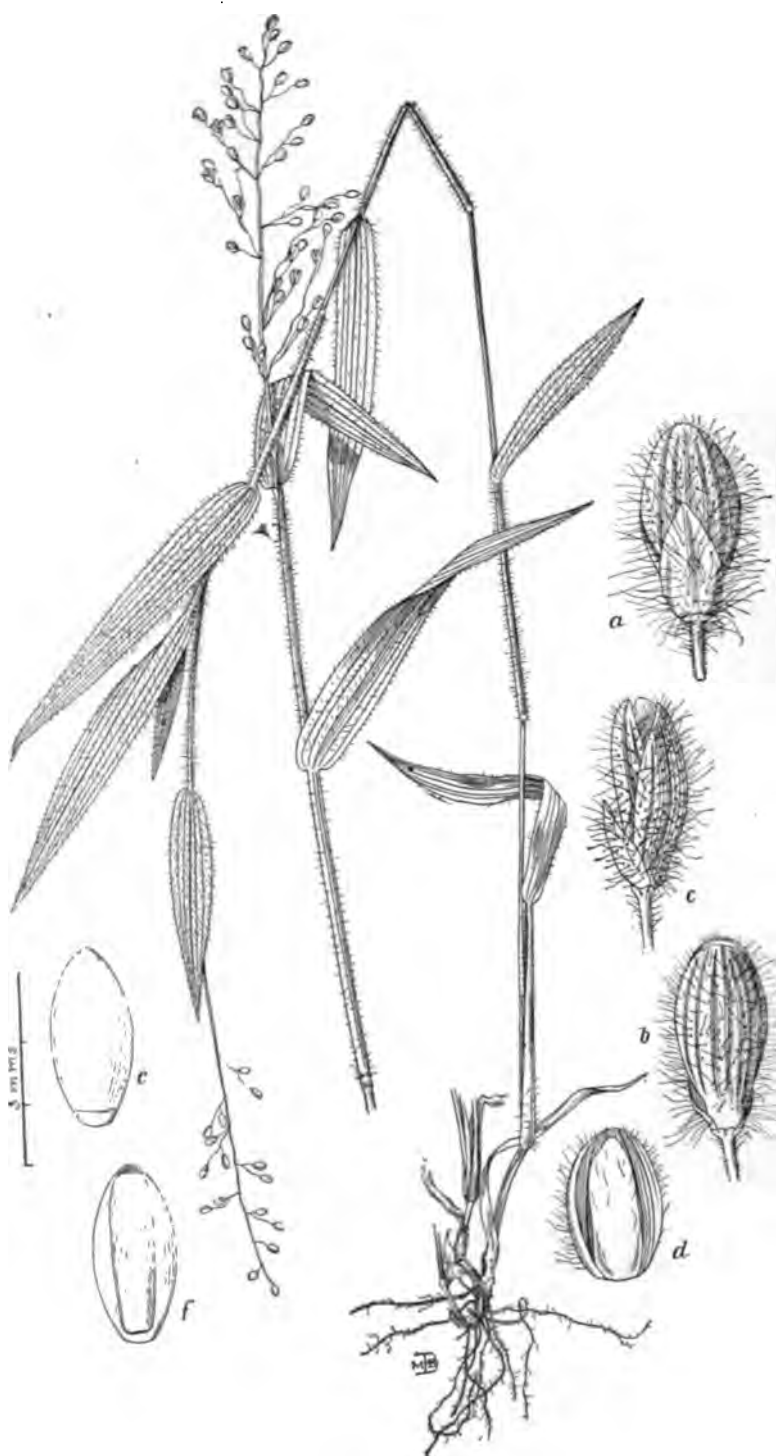


FIG. 56. *Panicum Leiberghii*. — *a*, Spikelets; *d*, flowering glume and palea.
(Div. of Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. Mt. Pleasant, 1507 (Mills); Emmet County, 1068 (Cratty); Story City, 2087 (Miss Rantschler and Sample); Ames (Beardslee, Bessey); Dubuque (Pammel); Greenfield (Stewart); Ames, 16 (Ball and Sample); Story City, 1915 (Pammel and Beyer); Story County (Hitchcock); Story City, 965 (Pammel); Johnson County (Shimek).

North America. From Minnesota to Iowa, the Dakotas, Nebraska and Missouri.

21. PANICUM SCRIBNERIANUM.

Panicum Scribnerianum
Nash. Bull. Torr. Bot. Club.
22: 421. 1895. Nash in Britton
and Brown Ill Fl. 1: 118. f.
259. 1896. Scribner. Bull. U.
S. Dept. Agr. Div. Agros. 17:
97. f. 393. 1899.

Panicum scoparium
Serenio Watson. In part, Gray
Man. 632. 1890. (6 ed.)

Panicum pauciflorum.
Gray Man. 613. 1848.

DESCRIPTION.

SCRIBNER'S PANICUM.

An erect and finally branching perennial 1 to 3 feet (1½-6 dm.) high, with usually papillate-pilose sheaths, more or less spreading, flat leaves which are smooth and scabrous beneath, and small ovoid panicles 1 to 1½ inches (2-3 cm.) long. Spikelets obovoid 1½ lines (3 mm.) long, nearly glabrous. In dry or moist soils. May to September.

Panicum Scribnerianum is common on prairies in all parts of the state. The close ally *P. Leibergii* occurs on lower ground.



FIG. 57. *Panicum Scribnerianum*.—a, b, c, Spikelets.
(Div. Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. New Hampton, 2295 (Rolf); Charles City (Arthur); Muscatine (Reppert); Iowa City (Hitchcock); Greene (Miss Price); Des Moines (Carver); Mt. Pleasant, 1914 (Mills); Cedar Rapids (Shimek); Tama County (Sirriner); Maquoketa (Goodenow); Green-

field (Stewart); Sioux City (Miss Wakefield); Colfax (Mead); Boone (Carver); Armstrong, 1068 (Cratty); Muscatine 2081, Story City, Marshalltown, New Albin 1925, Missouri Valley 658, Council Bluffs, Carroll 1430, De Witt 1446, New Albin 932, Council Bluffs 1306, De Witt 1443, Ottumwa 2182 (Pammel); Ames (Bessey, Sirrine, Hodson, P. H. Rolfs 178, Ball, Beardslee, Crozier); Woodbine 24 (Burgess); Johnson County (Miss Linder, Shimek); Cedar Rapids, Lyon County (Shimek); Johnson County (Hitchcock and Macbride); Lineville (Shimek).

North America. Maine to Ontario, New York, Tennessee, Arizona, Missouri (Independence, Bush-729), Nebraska (Crete, Pammel; Alma, Pammel); Iowa, Minnesota (Minneapolis, Sandberg); Wisconsin (Madison and La Crosse, Pammel); westward to Wyoming and southward to Texas and Arizona.

22. PANICUM ATLANTICUM.

Panicum Atlanticum

Nash. Bull. Torr. Bot. Club. 24: 346 1897. Scribner. Am. Grasses. Bull. U. S. Dept. Agr. Div. Agros. 17: 76. f. 372. 1899. Nash in Britton and Brown. Ill. Fl. 3: 500, f. 25.

Panicum haemacarpum

A. he. Jour. E. Mitch. Sci. Soc. 15: 55. 1898.

DESCRIPTION.

ATLANTIC PANIC GRASS.

A slender, erect, much-branched perennial, 1 to 2 feet (3-5 dm.) high, with the culm sheaths, and erect, linear-lanceolate leaves, papillate-pilose with long, white, spreading hairs. Panicle 2 to 3½ inches (4-6½ cm.) long. Spikelets obovate, obtuse, about 1 line (2 mm.) long, the nine-nerved second and third glumes densely pubescent with short, spreading hairs. In open woods.

DISTRIBUTION.

Iowa. Jewell Junction (Carver), Missouri Valley (Pammel).

North America. Maine, Virginia, and west to Iowa and Nebraska (Hastings, Pammel), and Kansas.

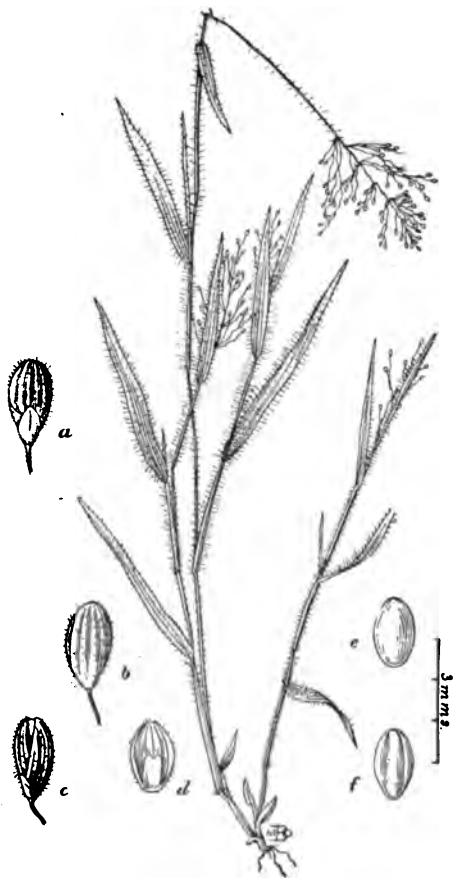


FIG. 58. *Panicum Atlanticum*.—a-c, Spikelets. (Div. of Agros. U. S. Dept. Agr.)

North America. In open woods from Maine and Virginia to Kansas, Nebraska, Iowa and Illinois.

23. PANICUM LANUGINOSUM.

Panicum lanuginosum Ell. Sk. Bot. S. C. & Ga. 1: 123. 1817. Nash in Britton and Brown. Ill. Fl. 3: 498. *f. 24a.* 1895.

Panicum Tennesseense Ashe. Jour. E. Mitch. Sci. Soc. 15: 52: 1898. It is not *Panicum pubescens* Lam. Encycl. 4: 748. 1797. See Scribner and Merrill. Rhodora. 3: 121.

DESCRIPTION.

HAIRY PANICUM. A slender, finally much-branched perennial, 6 to 20 inches (12-40 cm.) high, with flat, erect, and rather thick, narrowly lanceolate leaves. Culms erect or assurgent, usually geniculate at the lower joints, branching throughout, especially above, villous or nearly smooth; nodes bearded; sheaths shorter than the internodes, densely villous or pilose, with long spreading hairs, very hairy at the throat; ligule a fringe of short hairs; leaf-blades on the primary culm 2 to 4 inches (4-8 cm.) long, 3 to 6 lines (6-12 mm.) wide, (those of the branches smaller) very acute, rounded at the base and somewhat clasping; margins minutely serrulate-scabrous and pilose; surfaces papillate-pilose with long white hairs, or nearly glabrous. Panicle of the primary culm about 3 inches (6 cm.) long, ovate or sub-pyramidal, the spreading branches solitary, or in pairs, compound to the base, scabrous or pilose; pedicels equalling or exceeding the spikelets in length. Panicles of the branches nearly simple and few-flowered, usually partially enclosed within the leaf sheaths. Spikelets 1 line (2 mm.) long, obovate, obtuse; first glume about one-fourth the length of the spikelet, obtuse or acute; second and third glumes pubescent, prominently seven-nerved; the third with a rather small palea; fourth glume smooth and shining, broadly obtuse. This grass is common in dry soil, prairies. May to September.



FIG. 59 — *Panicum lanuginosum*. (Charlotte M. King.)

Panicum lanuginosum is a variable species and can only be separated arbitrarily from *P. unciphyllum*. Perhaps we ought to regard the two as one variable polymorphic species.

DISTRIBUTION.

Iowa. Mt. Pleasant, 1916 (Mills); De Witt, 1444 (Pammel); Ames, Iowa City (Hitchcock); Ames, 27 (Bessey); Lineville (Shimek); Charles City (Pammel); Clermont (Walker).

North America. In dry, open, woodland soil from New Jersey, D. C. (Washington, Vasey), to Florida and Alabama; Washington (Kittitas County, Sandberg), Missouri (Webster, Pammel).

24. PANICUM UNCIPHYLLUM,

Panicum unciphyllum Trin. Gram. Pan. 242. 1826. Scribner and Merrill. Rhodora 3: 121. 1901. Britton Man. 1040. 86.

Panicum pubescens A. Gray. not Lam. Britton Man. 86.

DESCRIPTION.

An erect, or ascending, caespitose, at length much branched, pubescent perennial, 1 to 2½ feet (3-8 dm.) high, with lanceolate leaves, exserted, ovate panicles and pubescent spikelets. Culms pilose with weak hairs; nodes sparingly bearded or smooth; sheaths striate, loose, usually shorter than the internodes, pilose with spreading or ascending hairs; ligule a long-ciliate fringe; leaf-blades ascending, firm or even rigid, acuminate, slightly narrowed at the rounded or truncate base, densely pubescent beneath with short spreading hairs, smooth above or often with scattered papillate hairs 2 to 5 inches (4-10 cm.) long, 2 to 6 lines (5-12 mm.) wide. Panicles 2½ to 5 inches (5-10 cm.) long, usually purplish, the branches spreading, generally few-flowered. Spikelets elliptical, obtuse, (1.5 mm.) long; first glume small, about one-fourth as long as the spikelet; second and third glumes equal, pubescent with spreading hairs.



FIG. 60. *Panicum unciphyllum*.—a. b. Spikelets. (Charlotte M. King.)

DISTRIBUTION.

Iowa. Muscatine, 2281 (Reppert); LuVerne, 2268 (Blumer); 2331 Steamboat Rock, Boone 2326, Steamboat Rock 2163, Des Moines, 2256 Bloomfield (Pammel); Boone (Carver); Armstrong, 1067 (Cratty); Ames (Bessey, P. H. Rolfs, 157, Ball); 1139, Durant (Weaver); Mt. Pleasant (Mills, Witte); Fayette, 1087 (Fink); Sioux City, Iowa City (Hitchcock); Ames 11 (Beardslee); Unionville (Shimek).

North America. New Brunswick to the Pacific Coast and south to Texas.

OTHER SPECIES OF PANICUM.

Several other species of *Panicum* range westward to Wisconsin and Minnesota and may be looked for in eastern Iowa. Among them *Panicum barbulatum*, *P. clandestinum*, *P. commutatum*, *P. dichotomum* and *P. sphaerocarpon* (*P. polyanthes* Schult). These are described by Scribner and Merrill *Rhodora* 3: 93.

3. SETARIA.

Setaria Beauv. *Agrost.* 113. 1812. Engler and Prantl. *Nat. Pflanz. Fam.* II. 2: 36. *f.* 29. Bentham and Hooker, *Gen. Pl.* 3: 1105.

Pennisetum Endlicher. *Gen. Pl.* 85. *Pers. Syn.* 1: 72. in part.

Ixobhorus Schlecht. *Linnaea.* 31: 420. 1861-2. Nash. *Bull. Torr. Bot. Club.* 22: 423. 1895.

Chaetochloa Scribn. *Bull. U. S. Dept. Agrl. Div. Agros.* 4: 38. 1897.

Chamaeraphis Kuntze. *Rev. Gen.* 767. (Not the *Chamaeraphis* of R Br.)

Spikelets as in *Panicum*, but surrounded at the base by few or many persistent, awn-like bristles (aborted branches) which spring from pedicels below the articulation of the spikelets. Inflorescence a densely many-flowered, cylindrical, or somewhat interrupted, spike-like panicle. Annuals with flat leaves and terminal, bristly, spike-like panicles.

Bentham & Hooker give the number of species as 10; the same number is given by Hackel. In temperate and tropical regions. All of our Iowa species are from the Old World.

KEY TO THE SPECIES OF SETARIA.

- Bristles downwardly barbed.....*S. verticillata*.¹
 Bristles upwardly barbed.
 Bristles 5-16 at base of each spikelet. Second empty glume much shorter than the flowering glume.....*S. glauca*.²
 Bristles 1-3 at base of each spikelet, second empty glume nearly or quite equalling the flowering glume.
 Spike-like panicle 2-8 cm. long, 1 cm. or less thick, spikelets 2 mm. long, bristles green.....*S. viridis*.³
 Spike-like panicle 5-20 cm. long, 1-3 cm. thick, spikelets 2.5 to 3 mm. long, bristles usually purple, cultivated.....*S. Italica*.⁴

1. SETARIA VERTICILLATA.

Setaria verticillata Beauv. Agrost. 51. 1812. Watson and Coulter in Gray's Man. Bot. 634. Vasey. Contr. U. S. Nat. Herb. 3: 39.

Panicum verticillatum L. Sp. Pl. 82. 1762. (2. ed.)

Chamaeraphis verticillata Porter. Bull. Torr. Bot. Club. 20: 196. 1893. Beal. Grasses. N. A. 2: 151.

Ixophorus verticillatus Nash. Bull. Torr. Bot. Club. 22: 422. f. 6. 1895. Britton and Brown. Ill. Fl. 1: 126. f. 280. 1896.

Pennisetum verticillatum R. Br. Prod. 1: 195. 1810.

Chaetochloa verticillata (L.) Scribn. Bull. Div. Agros. U. S. Dept. Agr. 4: 39. Scribner & Merrill. Bull. U. S. Dept. Agr. Div. Agr. 21: 16. f. 6.

DESCRIPTION.

WHORLED MILLET. A low, spreading, much-branched annual, $\frac{1}{2}$ to 1 foot (1-3 dm.) high, with short, cylindrical spikes and lanceolate leaves, $1\frac{1}{2}$ to 3 inches (3-6 cm.) long. Culms compressed, geniculate, decumbent, very glabrous; nodes smooth; sheaths very loose, striate, compressed, glabrous, margins smooth, shorter than the internodes; ligule short, densely ciliate-fringed with white hairs; leaf blades $1\frac{1}{2}$ to 3 inches (3-6 cm.) long, 2 to 4 lines (4 to 8 mm.) wide, cordate at the base, long-acuminate at the apex, scabrous, and sparingly papillate-ciliate on both sides, especially below, margins cartilaginous, serrulate-scabrous. Inflorescence dense, cylindrical, 1-3 cm. in diameter, purplish; common axis angular, scabrous, branches very short, subverticillate, densely flowered, setae 1-2, purple, stout, flexuous, retrorsely scabrous, 3-8 mm. long. Spikelets 1.5-2 mm. long, nearly sessile, elliptical-ovate; first glume triangular ovate, acute or obtuse, 3-nerved, about one-third the length of the spikelet; second glume ovate, obtuse, 5-7 nerved,



FIG. 61. *Setaria verticillata*—a, spikelet showing bristle and glumes; b, spikelet (Div. Agros. U. S. Dept. Agrl.)

nearly equaling the 5-7 nerved, acute third glume, which bears a short palca in its axil; flowering glume about 1.5 mm. long, elliptical, ovate, acute, striate, nearly smooth or very finely transversely wrinkled below. Palea similar in texture and markings, about as long as the glume.

DISTRIBUTION.

Iowa. Muscatine 520 (Reppert); 929 Mt. Ayr (Beard); Iowa City (Hitchcock); 773 Mt. Pleasant (Mills); Council Bluffs, 1449 De Witt, 1300 Council Bluffs (Pammel); Keokuk (P. H. Rolfs); LeClaire (F. M. Rolfs); Winterset (Carver); 2231 Ft. Dodge (Pammel and Sokol); Johnson County (Miss Linder, Hitchcock and Macbride).

North America. From New England, New Jersey (New Brunswick, Halsted) to Virginia, Alabama, Texas, Mexico, to Missouri (St. Louis, Pammel), Nebraska, Iowa and Illinois. Nova Scotia to New Brunswick and Ontario.

2. SETARIA GLAUCA.

Setaria glauca Beauv. Agros. 51. 1812. Watson and Coulter. Gray. Man. Bot. 634. pl. 13. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 56. f. 62. 1894. Vasey. Contr. U. S. Nat. Herb. 3: 38.

Panicum glaucum L. Sp. Pl. 56. 1753.

Chamaeraphis glauca Kuntz. Rev. Gen. Pl. 767. 1891. *Chamaeraphis glauca* (L.) Kuntz. Beal. Grasses N. A. 2: 155. 1896.

Ixophorus glaucus Nash. Bull. Torr. Bot. Club. 22: 423. 1895. Nash in Britton and Brown. Ill. Fl. 1: 126. f. 281. 1896.

Chaetochloa glauca (L.) Scribn. Bull. U. S. Dept. Agrl. Div. Agros. 17: 105. f. 401. 1899. Bull. U. S. Dept. Agrl. Div. Agros. 4: 39. 1897. Scribner and Merrill. Bull. U. S. Dept. Agrl. 21: 9. f. 1. 1900.

DESCRIPTION.

YELLOW FOX TAIL OR PIGEON GRASS. An erect annual, 1 to 2 feet, ($2\frac{1}{2}$ -5 dm.) high, with flat leaves and a bristly, cylindrical, spike-like, densely flowered panicle, 1 to 3 inches (2-6 cm.) long. Culm scabrous just below the panicle, otherwise smooth. Sheaths smooth; ligule a dense fringe of smooth hairs; leaf-blade 3 to 10 inches (6-20 cm.) long, 2 to 5 lines (4-10 mm.) wide, nearly smooth on the dorsal surface, very scabrous on the upper surface and margins, and occasionally pilose near the base. Axis of the panicle densely pubescent. Bristles five to ten on each spikelet, yellowish or rarely purplish. Spikelets ovoid, about $1\frac{1}{2}$ lines (3 mm.) long. First glume about $\frac{1}{2}$ line (1 mm.) long,



FIG. 62. *Setaria glauca*.—a, spikelet showing the second glume, the upper portion of the flowering glume and bristles; b, spikelet showing the back of the first and third glumes. (Div. Agros. U. S. Dept. Agrl.)

three-nerved, second nearly half the length of the spikelet, five-nerved; the third five-nerved and as long as the transversely rugose, flowering glume. Fields and waste places about dwellings. June to September.

Pigeon grass is abundant in all parts of the state, introduced by the earliest settlers. A pernicious weed in all cultivated fields.

DISTRIBUTION.

Iowa. High Bridge (Lummis); State Center (Pammel); Postville 3347, 3006, 3151 Lansing, 3164 Steamboat Rock, 3058 Pilot Mound (Miss King); Jackson County, Keokuk (Shimek); Calhoun County (Rigg); 3047 and 3283 Steamboat Rock, Eagle Grove, Carroll, Dakota City, 883 Slater, Jefferson, Marshalltown, Clinton, Carnarvon, 1450 De Witt (Pammel); Gilbert, Jewell Junction, Indianola (Carver); Ames (Zmunt, Fairfield, 910 Wadleigh, Hitchcock, Ketterer, 180 Ball, Sirrine, Pammel, Bessey); 3346 Marathon (Roberts); 957 Battle Creek (Preston); 647 Mt. Ayr (Beard); LeClaire (F. M. Rolfs); 740 Dixon (Snyder); Dysart (Miss Sirrine); Sioux City (Miss Wakefield); Taylor County (Pool); Keokuk, Lawler (P. H. Rolfs); Marshalltown (Stewart); Mt. Pleasant (Witte); Fayette (Fink); 743, Emmet County (Pammel and Cratty); Muscatine (Reppert); Belmond (Clark); Manly (Williams); West Union (Whitmore); 832 Belknap (Rankin); Anderson, Charles City, 848 Libertyville (Baldwin); Marshalltown (Eckles); Red Oak (Holt); Keokuk (Shimek); Council Bluffs (Misses Cavanagh and Dilne); Johnson County (Hitchcock and Macbride); Algona (Watson).

North America. Maine, Connecticut, New York to Florida; Alabama, Texas (Navasota, Blackshear), Louisiana (Ball), Arkansas (Rolfs), Mexico, Colorado (Petersburg, Pammel, Johnson, Lummis and Buchanan), (La Porte, Pammel and Johnson), Iowa, Minnesota, Missouri (St. Louis, Pammel), Nebraska (Crete, Pammel, 207), the Dakotas, Wisconsin (LaCrosse, C. M. King); New Brunswick to Saskatchewan.

General. From British Islands, Germany, France and east to Asia and Australia.

3. SETARIA VIRIDIS.

Setaria viridis. Beauv. Agros. 51. 1812. Watson and Coulter in Gray's *Man. Bot.* 634. (6 ed.) Lamson-Scribner, *Grasses of Tenn.* Bull. Univ. of Tenn. Agrl. Exp. Sta. 7: 56. *pl.* 16. *f.* 63. 1894.

Panicum viride L. Sp. Pl. 83. 1762. (2 ed.)

Ixophorus viridis Nash. in Ill. Fl. 1: 126. *f.* 282. 1896.

Chamaeraphis viridis L. Porter. Bull. Torr. Club. 20: 196. 1893. Beal. *Grasses of N. A.* 2: 157. 1896.

Chaetochloa viridis Scribn. Bull. U. S. Dept. Agrl. Div. Agros. 4: 39. 1897—7: 71. *f.* 65. 1900.

DESCRIPTION.



FIG. 68. *Setaria viridis*. a. spikelet with bristles; b, c, spikelets with glume, bristles removed; d, flowering glume. (Div. of Agros. U. S. Dept. Agrl.)

GREEN FOX TAIL. An erect, glabrous, caespitose annual, $\frac{1}{2}$ to 3 feet (2-9 dm.) high, with short, lanceolate leaves and dense, cylindrical spike-like, green panicles 1 to 4 inches (2-10 cm.) long. Culms usually much branched at the base, glabrous; nodes smooth; leaf-blades 2 to 10 inches (.5-2.5 dm.) long, 2 to 5 lines (4-10 mm.) wide, long-acuminate, slightly scabrous on both sides; setae slender, strict, spreading, antrorsely scabrous, 5 to $7\frac{1}{2}$ lines (1-1.5 cm.) long, green or rarely purplish. Spikelets about 1 line (2 mm.) long; second and third glumes five-nerved, equalling the spikelet; flowering glume elliptical, rounded at the apex, finely and faintly transversely wrinkled below, or only striate and pitted. In waste places and cultivated grounds throughout North America. July to September.

Fox tail grass is abundant in all parts of the state, everywhere a pernicious weed in cultivated fields.

DISTRIBUTION.

Iowa. 28 Des Moines, 1007 Manchester, 268 Clinton, Wheatland (Ball); Dakota City, Eagle Grove, Elmore, Minn., Minnesota-Iowa line, Carroll, 1023 Kossuth County, Webster City, Jefferson, Council Bluffs, Carnarvon, Dakota City, Sioux City, 2261 Des Moines, 2220 Webster City, Muscatine, Des Moines, Mason City (Pammel); Ames (Zmunt, Stewart, Fairfield, C. A. Wilson, Ketterer, Hitchcock, Weaver, Ball, Serrine); 3285 Steamboat Rock (Miss

King); Hamilton to Hancock County (Preston); Rock Rapids, Keokuk County, Forest City, Johnson County (Shimek); 808 Kossuth County (Pammel and Cratty); Decatur County (Fitzpatrick); Indianola (Carver); 1085 Fayette (Fink); Dysart (Miss Serrine); West Union (Whitmore); Jewell Junction (Carver); Cedar Rapids (Miss Hall); 692 Glenwood (Jackson); Montrose (Osborn); Sioux City (Miss Wakefield); 712 Amana (Schadt); 23 Forest City (Shimek); Mt. Pleasant (Mills); Lawler (P. H. Rolfs); Battle Creek (Preston); Van Cleve (Warden); 1136 Durant (Weaver); Alden (Stevens); Boone (Carver); West Union (Whitmore); Le Claire (F. M. Rolfs); Indianola (Carver); Johnson County (Fitzpatrick); 716 Dixon (Snyder); Plymouth County (Brown).

North America. From Maine, New York (Washington County, Parry); Connecticut (Glastonbury, Wilson), New Jersey (Shelton, Halsted), District of Columbia (Washington, Vasey), south to Florida; Alabama to Texas (Buckley), Mexico, Utah to Colorado (Ft. Collins, Cowen), Nebraska (Grand Island, Broken Bow 18, 74, Pammel; Crete, Pammel, 200; Kearney, Holms), the Dakotas, Iowa, Minnesota (Sand Lake, Sandberg), (Winona, Holsinger), Wisconsin (La Crosse, 3127 D. S. Pammel; La Crosse, Pammel), Illinois (Chicago, Pammel); Nova Scotia, Manitoba and Saskatchewan.

General. Great Britain through Germany, Denmark and warmer portions of Europe generally. Asia (India), China, Japan, Africa, Australia and South America.

4. SETARIA ITALICA.

Panicum Italicum L. Sp. Pl. 56. 1753.

Setaria Italica Beauv. Agros. 51. 1812. R. & S. Syst. 2: 423. 1817.

Setaria Italica Kunth. Watson and Coulter in Gray Man. Bot. 634. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 56. f. 64. 1894.

Chamaeraphis Italica (L.) Kuntze. Rev. Gen. Pl. 768. 1891. Beal. Grasses of N. A. 2: 154. 1896.

Ixophorus Italicus (L.) Nash. Nash in Britton and Brown Ill. Fl. 1: 127. f. 283. 1896. Bull. Torr. Bot. Club. 22: 423. 1895.

Chaetochloa Italica (L.) Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 74. f. 68. 1900. (3d ed.) Scribner and Merrill. Bull. U. S. Dept. Agrl. Div. Agros. 21: 20. f. 9. 1900. Bull. U. S. Dept. Agrl. Div. Agros. 4: 39. 1897.

*The *Setaria Germanica* is considered a good species by some botanists.

Setaria Germanica Beauv. Agros. 51. 1812. Scribn. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 58. 1894. *Panicum Germanicum* (Mill.) Gard. Dict. 1. 1758. (8th ed.) *Chaetochloa Italica* var. *Germanica* (Mill.) Scribn. Scribner. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 21: 21.

DESCRIPTION.

GERMAN MILLET.—A caespitose annual, from 1 to 3 feet (3-9 dm.) high, with narrow panicles, about $\frac{1}{4}$ inch (1 cm.) in diameter, and long, usually purple setae, some forms approaching *Setaria viridis*.



FIG. 64. *Setaria Italica*.—a, b, Spikelets with bristles; c, flowering glume. (Div. Agros. U. S. Dept. Agrl.)

DESCRIPTION.

ITALIAN MILLET OR HUNGARIAN GRASS. A stout, erect, somewhat glaucous annual, 3 to 8 feet (10-24 dm.) high, with broad leaves and large, dense, compound, spiciform panicles 3 to 8 inches (8-20 cm.) in length. Nodes bearded, with short, appressed hairs; leaf-blades lanceolate, narrowed at the base, long-acuminate, 8 to 16 inches (2-4 dm.) long, $\frac{1}{2}$ to $1\frac{1}{4}$ inches (1 $\frac{1}{2}$ -3 cm.) wide, scabrous. Panicles dense, cylindrical, $\frac{1}{2}$ to $1\frac{1}{2}$ inches (2-3 cm.) in diameter; rachis densely villous; setae one to three, green or purplish, antrorsely scabrous. Spikelets elliptical, strongly convex, $1\frac{1}{2}$ to 2 lines (2 $\frac{1}{2}$ -3 mm.) long, obtuse; second and third glumes about equalling

the flowering glume, five to seven-nerved; flowering glume glossy, nearly smooth. Widely cultivated. Quebec to Minnesota, south to Florida and Texas. July to September.

This form is usually regarded as only a variety of the Italian Millet, and is only found in cultivation or perhaps springing up from seed on land where cultivated the season previous. The German differs from the Italian Millet in having a more dense or compact, and usually erect panicle or "head." Widely cultivated in most parts of the world.

DISTRIBUTION.

Iowa. Forms which may be regarded as this have been found in Carnarvon, Carroll, Jefferson (Pammel); 924 Emmet County (Pammel and Cratty); Scott County, (Bartsch); Waterloo (Hitchcock).

North America. Occasionally spontaneous after cultivation in the eastern, southern and northwestern states and on the Pacific Coast.

Millet or Hungarian grass is widely cultivated in this state; generally as a catch crop. It has established itself chiefly in cities and along railroads.

DISTRIBUTION.

Iowa. Le Claire (F. M. Rolfs); Waterloo (Hitchcock); 924 Emmet County (Pammel and Cratty); Carnarvon, Sioux City, Jefferson, Carroll, Boone, Dakota City, Turin, Logan (Pammel); 3144 and 3046 Pilot Mound (Miss King and A. MacCorkindale); Mt. Pleasant (Mills); 1137 Durant (Weaver); 27 Des Moines (Ball); Ames (181, 1026 Ball, Fisher, Crozier, Hitchcock, Pammel); West Union (Whitmore); Van Cleve (Warden); Boone (Carver); 267 Clinton (Ball).

North America. From New England to Texas, Nebraska (Crete, Pammel), Iowa, Wisconsin (La Crosse, Pammel; D. S. Pammel and C. M. King 3256 and 3316), and occasionally on the Pacific Coast. An introduced species.

General. Native to Europe and Asia. Its cultivation seems to have been quite common in the temperate regions of Europe and Asia in prehistoric times.

4. CENCHRUS.

Cenchrus L. Sp. Pl. 1049. 1753. Endlicher. Gen. Pl. 85. Bentham and Hooker. Gen. Pl. 3: 1105. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 36. f. 30. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 40. f. 26.

Spikelets as in *Panicum*, awnless, but enclosed, 1 to 5 together, in a globular and bristly or spiny involucre, which becomes coriaceous, and forms a deciduous, hard and rigid bur; the involucre sessile in a terminal spike. Styles united below. (An ancient Greek name for *Setaria Italica*.)

About twelve species occur in the tropical and warmer temperate regions. One species common from Maine to New York, south to Florida, west to Texas, Mexico, California; through Kansas, Colorado, Iowa, Minnesota, Dakota and Ontario.

CENCHRUS TRIBULOIDES.

Cenchrus tribuloides L. Sp. Pl. 1050. 1753. Watson and Coulter. Gray. Man. Bot. 634. pl. 14. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 57. f. 65. 1896. Bull. U. S. Dept Agrl. Div. Agros. 7: 75. f. 69. 1900. (3d ed.) Beal. Grasses N. A. 2: 161. f. 29. 1896. Nash in Britton and Brown. Ill. Fl. 1: 127. f. 264. 1896.

Cenchrus Carolinianus Walt. Fl. Car. 79. 1788.

DESCRIPTION.

SAND BUR. Annual, with spreading or ascending, much branched culms, rarely a foot high, somewhat compressed. Leaves flat or simply folded, about six inches long, acute, finely serrulate along the margins; sheaths generally much exceeding the internodes, hairy along the margins and at the throat. Burs containing the spikelets, six to twenty, nearly globose, covered with strong, and more or less pubescent, barbed spines, becoming very hard at maturity and readily falling off. Sandy soils and tracts. June to October.

Sand bur is widely distributed in the state, occurring on sand bars and flood plains of streams especially in central, northern and eastern Iowa. The most abundant weed on Muscatine Island. It is also common where sand ballast is used on railroads.



FIG. 65. *Cenchrus tribuloides*—a, spiny bur which incloses the spikelets; b, section of the same; c, lateral view of one of the spikelets. (Div. Agros. U. S. Dept. of Agrl.)

DISTRIBUTION.

Iowa. Ames 112 (Ball, Bessey, Hitchcock); 3201 (Hunt and Rolfs); Boone (Carver); Maquoketa (Goodenow); Manchester 989 (Ball); Mt. Pleasant (Mills); Fayette County (Fink); Cedar Rapids (Miss Hall); Sioux City (Miss Wakefield); Keystone (Koch); Law-

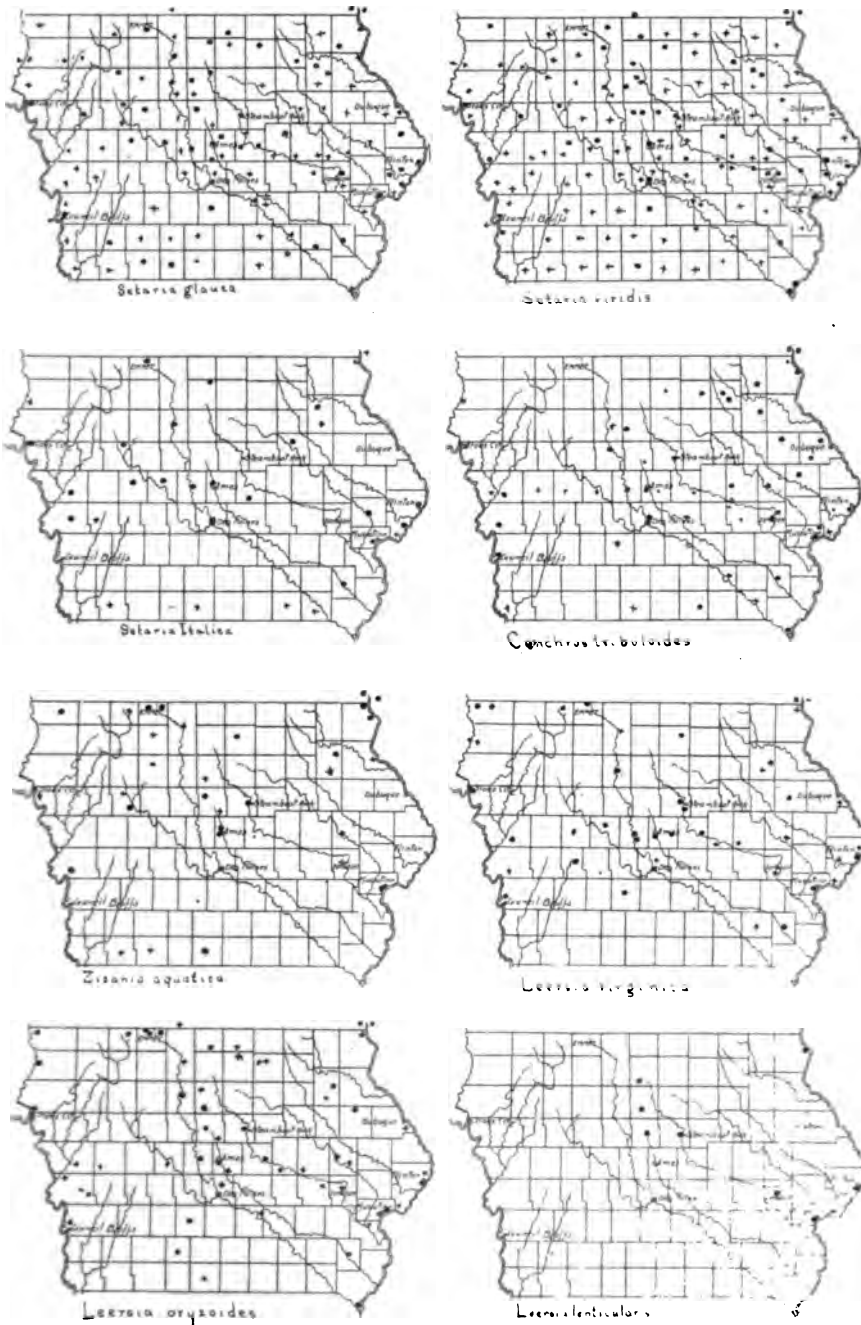


FIG. 66. Distribution of *Setaria*, *Zizania*, *cenchrus* and *Leersia*.
 ● Specimens in herbarium. † Based on observation.

ler, New Hampton, Keokuk (P. H. Rolfs); Ft. Dodge (Bessey); Muscatine (Reppert); Decatur County (Fitzpatrick); Lansing 3005, Steamboat Rock 3161 and 3030 (Miss King); Turin 679, Des Moines, Council Bluffs, Eagle Grove, Wilton Junction, 1514 Missouri Valley, Hawarden, Clinton, De Witt 1460, Sioux City (Pammel); Manchester (Blair); Council Bluffs (Misses Cavanagh and Dilne); Iowa City (Macbride); Johnson County (Miss Linder); Dubuque County (Bartsch and Fitzpatrick); Winneshiek County (Goddard); Council Bluffs (Miss Cavanagh); Charles City (Sherman).

North America. From Maine, New Jersey (Vasey), (Dr. Kniskern), Virginia (Marshall Hall, Pammel), Ohio (Cleveland, M. Nichol; Painsville, Beardslee), south to Florida (Du Val County Curtiss), Alabama (Mobile, Mohr.), west through Texas (College Station, Navasoto, Pammel; Nealley); California, Mexico (Palmer). New Mexico (Socorro, Vasey, 186); Kansas, Nebraska (McCook, Pammel; Chelsea, Clements, 2827), Minnesota (Crow Wing County, Sandberg); Wyoming (Griffith, 743), Wisconsin (La Crosse, Pammel; D. S. Pammel and C. M. King 3018), Illinois (Chicago Pammel), Michigan (Grand Rapids, Crozier).

5. PENNISETUM.

Pennisetum Pers. Syn. 1: 72. 1805. Endlicher. Gen. Pl. 85. in part. Bentham and Hooker Gen. Pl. 3: 1105. Hackel Engler and Prantl. Nat. Pflanz. Fam. II. 2: 38. f. 32. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 41. f. 27.

DESCRIPTION.

Spikelets solitary or 2-3 together, subtended by an involucre of one to many bristles, which are often plumose and fall off with the spikelets at maturity; inflorescence racemose, or dense and spike-like. Glumes 4; the first empty and smaller than the others; the second usually as long as the spikelet, empty; the third empty, or with a palea or a staminate flower; the fourth, or terminal, inclosing a pistillate or hermaphrodite flower and palea. Stamens 3. Styles distinct or more or less connate below; stigmas plumose. Grain included in the rigid fruiting glume and palea, free. Annual or perennial grasses, with simple or branched culms; flat leaves, with usually spike-like panicles terminal on the culms or its branches.

About 40 species, chiefly native to the tropical and subtropical regions of the Old and New Worlds. Some 12 species native to Mexico and Central America. Eight species are recorded for the United States. *Pennisetum setosum* is native to Florida and Mexico. One species, *Pennisetum typhoideum* is grown under the name of Pearl Millet and has been cultivated of late years in Iowa.

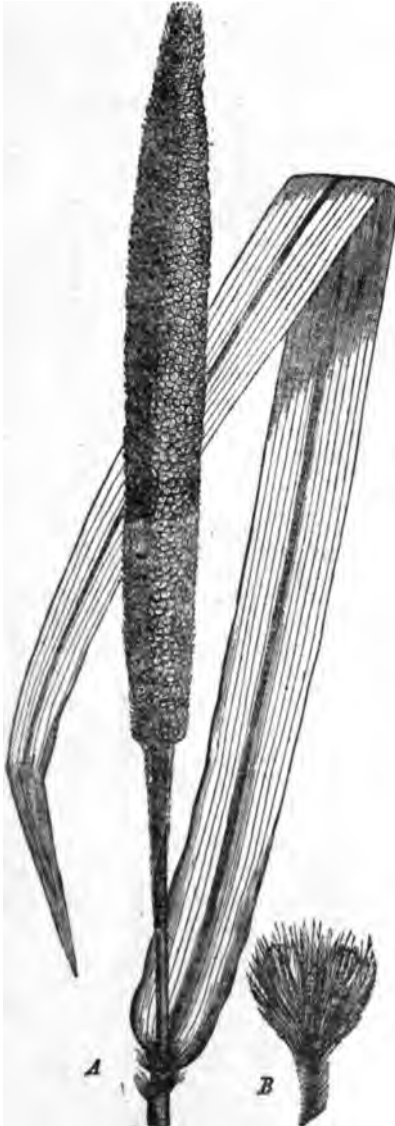


FIG. 87. *Pennisetum typhoideum*. After Hackel.

The *Pennisetum longistylum* of Abyssinia is sometimes cultivated as an ornamental grass.

TRIBE VI.—ORYZEÆ.

Spikelets usually much compressed laterally, 1-flowered, staminate, pistillate, or hermaphrodite; empty glumes 2 or none, the flower being



FIG. 88. Spikelet of *Leerstia oryzoides*.

subtended by the floral glume and palea alone, the latter 1-nerved and regarded by some as a second glume; stamens frequently 6; axis of the inflorescence not articulated.

A small tribe of about forty species, divided among sixteen genera, mostly confined to tropical America. The best known representative in Iowa is rice-

cut grass (*Leersia*), of which there are three species, and another representative, wild rice (*Zizania*), but the most important member is the rice (*Oryza sativa*), of the Old World, because of its extensive use as a cereal.

KEY TO THE GENERA OF THE ORYZEÆ.

- Spikelets unisexual, plants monoecious..... *Zizania*.¹
 Spikelets perfect, strongly compressed..... *Leersia*.²

1. ZIZANIA.

Zizania L. Sp. Pl. 991. 1753. Endlicher. Gen. Pl. 78. Bentham and Hooker. Gen. Pl. 3: 1115. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 40. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: f. 33.

Hydropyrum Link. Hort. Berol. 1: 252.

Flowers monoecious; the staminate and pistillate both in 1-flowered spikelets in the same panicle. Glumes 2, subtended by a small cartilaginous ring, herbaceo-membranaceous, convex, awnless in the sterile, the lower one tipped with a straight awn in the fertile spikelets. Palea none. Stamens 6. Stigmas pencil-form. Large, often reed-like, water grasses. Spikelets jointed upon the club-shaped pedicels, very deciduous. (Adopted from the Greek word for the ancient name of some wild grain.)

A monotypic genus in North America, from Maine to Florida and Texas; Arkansas, Nebraska, Iowa, Dakota, Minnesota, Wisconsin, New Foundland and Ontario.

ZIZANIA AQUATICA.

Zizania aquatica L. Sp. Pl. 991, 1753. Watson and Coulter. Gray. Man. Bot. 635. pl. 7. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 58. 1894. Bull. U. S. Dept. Agr. Div. Agros. 17: 113. f. 409, 1899. Nash in Britton and Brown Ill. Fl. 1: 128. f. 286. 1896. Beal. Grasses of N. A. 2: 173. f. 34. 1896. Vasey Contr. U. S. Nat. Herb. 3. 41.

DESCRIPTION.

WILD RICE. A stout, erect, aquatic annual, 5 to 17 feet (9-30 dm.) high, with broad, flat leaves and large panicles, 10 to 20 inches (30-60 cm.) long. Staminate spikelets 3 to 6 lines (6-12 mm.) long, awnless; the pistillate spikelets 4 to 12 lines (8-24 mm.) long, the outer one bearing an awn 12 to 24 lines (24-48 mm.) long. Grain linear 5 to 8 lines (10-16 mm.) long. Swamps and shallow margins of sluggish streams and rivers. June to October.

Wild rice is most frequent in northern Iowa in the lake region. Common also along the Mississippi and northern Missouri in Iowa. Though once common in the vicinity of Ames, it has now disappeared.



FIG. 69. *Zizania aquatica*.—a, pistillate spikelet; b, palea and flower; c, staminate spikelet. (Div. Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. 3039 Steamboat Rock, 3139 Lansing (Miss King); Ames (beyond Hammond's Mill); 1294 Jewell Junction (Pammel); Cedar

Rapids (Shimek); Ames (Crozier, Hitchcock); Clear Lake, Cedar Rapids (Hitchcock); Estherville (Cratty); 764 Armstrong (Pammel and Cratty); Fayette (Fink); Rock Rapids (Miss Wakefield); 972 Armstrong (Pammel and Cratty); 471 Muscatine (Reppert); Decatur County (Fitzpatrick); Mud Lake (Miss Fish); Rock Rapids (Shimek).

North America. New Brunswick, Quebec, Ontario, Manitoba, Maine, New York, to Carolina and Florida; west to Alabama and Texas, Arkansas, Missouri (Pammel), S. Dakota (Huron, Griffith), Iowa, Minnesota (Pine Creek, Pammel), Wisconsin (La Crosse, Madison, Dead Lake, Pammel; Burlington, Parry; Pewaukee Lake, Parry); Illinois (Bluff Lakes, Eggert; Graceland, Pammel), Ohio (Columbus, Sullivant; Baltimore, Horr).

General. From Central Siberia to Japan under the name of *Z. latifolia*, which is nothing more than a variety of the North American species.

2. LEERSIA.

Leersia. Swartz. Nov. Gen. Sp. Pl. 21. 1788. Bentham and Hooker. Gen. Pl. 3: 1117. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 41.

Leersia Soland. Sw. Fl. Ind. Occ. 1: 119. Endlicher Gen. Pl. 78.

Homalocenchrus Mieg. Hall. Stirp. Helv. 2: 201. 1768. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 50. f. 35. 1900.

Ehrhartia Wigg. Prim. Fl. Holsat 63. 1780.

Flowers crowded in one-sided, panicle spikes or racemes, perfect, but those in the open panicle usually sterile by the abortion of the ovary. Those enclosed in the sheaths of the leaves close-fertilized in the bud and prolific. Spikelets 1-flowered, flat, more or less imbricated over each other, jointed upon the short pedicels. Glumes 2, chartaceous, strongly flattened laterally or conduplicate, awnless, bristly-ciliate on the keels, closed, nearly equal in length, but the lower much broader, enclosing the flat grain. Palea none. Stamens 1-6. Stigmas feathery, the hairs branching. Perennial, marsh grasses; the flat leaves, sheaths, etc., very rough upward, being clothed with very minute, hooked prickles. (Named after John Daniel Leers, a German botanist.)

Species five, although some writers give the number as six. Found in the warmer regions of temperate America; one species (*Leersia oryzoides*), has been widely naturalized in Europe, Africa and Asia.

KEY TO THE SPECIES OF LEERSIA.

Spikelets oblong, their width less than $\frac{1}{2}$ their length.

Spikelets 2.5-3 mm. long, usually dark green.....*L. Virginica*.¹

Spikelets 4-5 mm. long, usually yellowish.....*L. oryzoides*.²

Spikelets oval, their width more than $\frac{1}{2}$ their length.....*L. lenticularis*.³

1. LEERSIA VIRGINICA.

Leersia Virginica Willd. Sp. Pl. 1: 325. 1797. Watson and Coulter Gray Man. Bot. 635. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 59. f. 68. 1894. Vasey Contr. U. S. Nat. Herb. 3: 42.

Leersia Virginica Michx. Fl. Bor. Am. 1: 37. 1803.

Asprella Virginica R. & S. Syst. 2: 266. 1817.

Homalocenchrus Virginicus (Willd.) Britton. Beal. Grasses N. Am. 2: 178. 1896. Nash in Britton and Brown. Ill. Fl. 1: 129. f. 287. 1896. Scribner Am. Grasses. Bull U. S. Dept. Agrl. Div. Agros. 7: 83. f. 77. 1900. (3d ed).

Homalocenchrus Virginicus Britton. Trans. N. Y. Acad. 9: 14. 1889.

DESCRIPTION.



FIG 70. *Leersia Virginica*.—a, branch of the inflorescence; b, c, spikelets. (Div. of Agros. U. S. Dept. of Agrl.)

WHITE GRASS. A slender, erect or ascending, usually much branched, leafy grass, 2 to 3 feet (4 or 6 dm.) high, from short, scaly root-stocks. Nodes pubescent with reflexed hairs. Sheaths retrorsely scabrous; ligule membranous, very short; leaf-blade linear or narrowly lanceolate, 2 to 5 inches (4-10 cm.) long, and 1 to 4 lines (2-8 mm.) wide, scabrous on both surfaces, and very minutely and sharply scabrous on the margins. Panicle 3 to 5 inches (6-10 cm.) long, simple, composed of a few more or less spreading, one-sided racemes, 1 to 3 inches (2-6 cm.) long. Spikelets $1\frac{1}{2}$ to 2 lines (3-5 mm.) long, strongly appressed to the branches and closely imbricated; glume very abruptly short-pointed, ciliate on the curved keel, and with a few very short, stiff hairs on the sides, or nearly smooth; palea similar to the glume, but narrower, and with nearly a straight keel.

Moist thickets and low woods, usually along streams. May to October.

Leersia Virginica occurs throughout the state in moist, alluvial thickets.

DISTRIBUTION.

Iowa. Mason City (Pammel); Steamboat Rock 3172 (Miss King); Winterset, Boone (Carver); Ledges, Boone County, 240 Clinton, Turin, Marshalltown, 110 Dakota City, Jefferson, 1082 Marshalltown (Pammel); 24 Granite (Shimek); Ames (Ball 139, Bessey); Muscatine (Reppert); Greenfield (Stewart); Iowa Lake, Emmet County 775 (Pammel and Cratty); Mt. Pleasant, 90 (Mills); Ames, Keokuk (Hitchcock); Libertyville (Baldwin); Manchester, 719 (Ball); Sioux City (Miss Wakefield); Mt. Pleasant (Mills); Fayette (Fink); Spirit Lake, Lyon County (Shimek); Nevada (Pammel) Steamboat Rock, Pine Creek (Miss King).

North America. From Maine to New York, New Jersey, Connecticut (Hartford County, Wilson 1267), North Carolina, Florida west to Alabama (Culman, Eggert), and Texas; Mississippi (Panola, Eggert), Louisiana (Richland Parish, Ball 17), Nebraska (Crete, Pammel, 198, 284), Missouri (St. Louis, Pammel; St. Louis, Eggert), South Dakota, Minnesota, Iowa, Wisconsin, Ohio (Baltimore, Horr).

2. LEERSIA ORYZOIDES.

Leersia oryzoides Swartz Fl. Ind. Occ. 1: 132. 1797. Watson and Coulter. Gray. Man. Bot. 635. pl. 7. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta 7: 60. f. 67. 1894. Vasey Contr. U. S. Nat. Herb. 3: 41.

Homalocenchrus oryzoides (L.) Mieg. Beal. Grasses of N. A. 2: 178. f. 37. 1896. Poll. Hist. Pl. Palat. 1: 52. 1776.

Homalocenchrus oryzoides (L.) Poll. Nash in Britton and Brown, Ill. Fl. 1: 129. f. 288. 1896. Scribner. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 7: 82. f. 76. 1900. (3d ed).

Phalaris oryzoides L. Sp. Pl. 55. 1753.

Ehrhartia clandestina Wigg. Fl. Holsat. 695. 1780.

Asprella oryzoides Lam. Ill. 1: 167. 1791.

Oryza clandestina A. Br. Asch. Fl. Brand. 799. 1864.

DESCRIPTION.

RICE CUT GRASS. A rather stout, rough and usually much branched grass, 2 to 3 or 4 feet (4-6 or 8 dm.) high, with flat leaves, and an open, pale green or straw-colored panicle. Nodes usually bearded.

67011

Sheaths auricled on the sides at the apex, strongly scabrous, the points of the minute spines which lie in the depressions of the striae, directed downwards; ligule firm-membranaceous, about a line long; leaf-blade 5 to 10 inches (10-20 cm.) long, 3 to 6 or 7 lines (6-12 or 14 mm.) wide, very acute, contracted and often pubescent at the base, scabrous on both surfaces, the margins very rough with minute sharp spines which in the lower part of the leaf are directed toward the base, and in the upper part are directed forward or towards the apex. Panicle 6 to 10 inches (12-20 cm.) long, the slender, ascending branches 2 to 4 inches (4-8 cm.) long, naked below, flower-bearing toward the ends. Spikelets 2 to $2\frac{1}{2}$ lines (4-5 mm.) long, about $\frac{3}{4}$ line ($1\frac{1}{2}$ mm.) broad, loosely imbricated; apex of the glumes and palea abruptly pointed, the keels strongly ciliate and with short scattered hairs on the sides. Within the lower sheaths may be found cleistogamic or hidden, fruiting spikelets. Along streams and ditches and in marshes, usually in the open. August to October. *Leersia oryzoides* is common along all of our streams and borders of marshes.



FIG. 71. *Leersia oryzoides*.—a, branch of inflorescence bearing several spikelets; b, c, spikelets; d, e, grain. (Div. Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. 3227 Boone, Dakota City, Hawarden, 241 Clinton (Pammel); 3029 Steamboat Rock (Miss King); Forest City (Shimek); Kossuth County, 790 (Pammel and Cratty); Decatur County (Fitzpatrick); Manchester, 731 (Ball); Mt. Pleasant, 863 (Mills); Iowa City (Hitchcock); Cedar Rapids, Ames (Hitchcock); Charles City

(Arthur); Woodbine (Burgess); Winterset, Boone (Carver); Armstrong, 1064 (Cratty); Creston, 1011 (Bettenga); Mt. Pleasant, 686 (Witte); Ames, 138 (Ball); Wild Cat Den, 1265 (Pammel and Reppert); Marshalltown (Stewart); Muscatine (Reppert); Keokuk (P. H. Rolfs); Fayette (Fink); near Hawarden (Pammel); Armstrong, 745 (Pammel and Cratty); Marshalltown (Eckles); Lake Okoboji (Miss Wakefield); Iowa Lake, 802 Emmet County (Pammel and Cratty); Hamilton to Hancock County (Preston); Granite, Spirit Lake (Shimek).

North America. From New England, New York (Madison County, Parry), to Florida, Alabama, Texas (Neally), Mexico, Colorado (Ft. Collins, Crandall), California, Oregon to Nebraska, the Dakotas (S. D. Redfield, Griffith), Iowa, Minnesota, Wisconsin (La Crosse, Pammel; Bloomington, D. S. Pammel and C. M. King), Illinois (Bluff Lakes, Eggert); Nova Scotia to New Brunswick, Quebec, Ontario and Saskatchewan.

General. This grass was early introduced into Europe and Asia; especially common in southern Europe where it has become a very bad weed along irrigation ditches. It has now spread to all the warm countries of Europe and Asia; found also in south America.

3. *LEERSIA LENTICULARIS.*

Leersia lenticularis Michx. Fl. Bor. Am. 1: 39. 1803. Watson and Coulter. Gray. Man. Bot. 635. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 60. f. 66. 1891.

Homalocenchrus lenticularis (Michx.) Kuntze Beal. Grasses of N. A. 2: 179. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 80. f. 74. 1900. (3 ed.) Kuntze Rev. Gen. Pl. 2: 777. 1891.

Homalocenchrus lenticularis (Michx.) Scribn. Nash in Britton and Brown Ill. Fl. 1: 129. f. 289. 1896. Scribn. Mem. Torr. Bot. Club. 5: 33. 1894.

DESCRIPTION.

CATCH FLY GRASS. A rather stout, branching perennial, 2 to 3 feet (4-6 cm.) high, from a creeping, scaly root-stock, with widely spreading, broad leaves and diffuse panicles. Nodes smooth or some-

times downwardly bearded. Sheaths firm, striate, smooth or more often rough, with downwardly pointed, sharp prickles, which lie in the grooves of the striae, auricled at the apex; ligule firm-membranaceous, about a line long, smooth or sometimes pilose on the back; leaf-blade 4 to 10 inches (8-20 cm.) long, 4 to 8 lines (8-16 mm.) wide, acute, contracted towards the base and on the back where the blade joins the sheath. Panicle 4 to 8 inches (8-16 cm.) long, the branches solitary or in pairs, widely spreading or finally deflexed, flower-bearing near the extremities. Spikelets on very short, scabrous pedicels, broadly oval, strongly flattened laterally, $2\frac{1}{2}$ to 3 lines (5-6 mm.) long, and about 2 lines (4 mm.) broad, closely imbricate, the glume and palea strongly bristly-ciliate along the keels. August to September.



FIG. 72. *Leersia lenticularis*—a, imbricated spikelets; b, glume and palea. (Div. Agros. U. S. Dept. Agrl.)

This species is confined to eastern Iowa and occurs in alluvial flood plains.

DISTRIBUTION.

Iowa. 3165 Steamboat Rock, 3142 Lansing (Miss King); Clinton, 242 (Pammel); Muscatine (Reppert); Iowa City (Hitchcock).

North America. Virginia to Tennessee, Alabama, Iowa, southwestern Wisconsin (?), through Missouri, Illinois (Hancock County, Arthur), Texas.

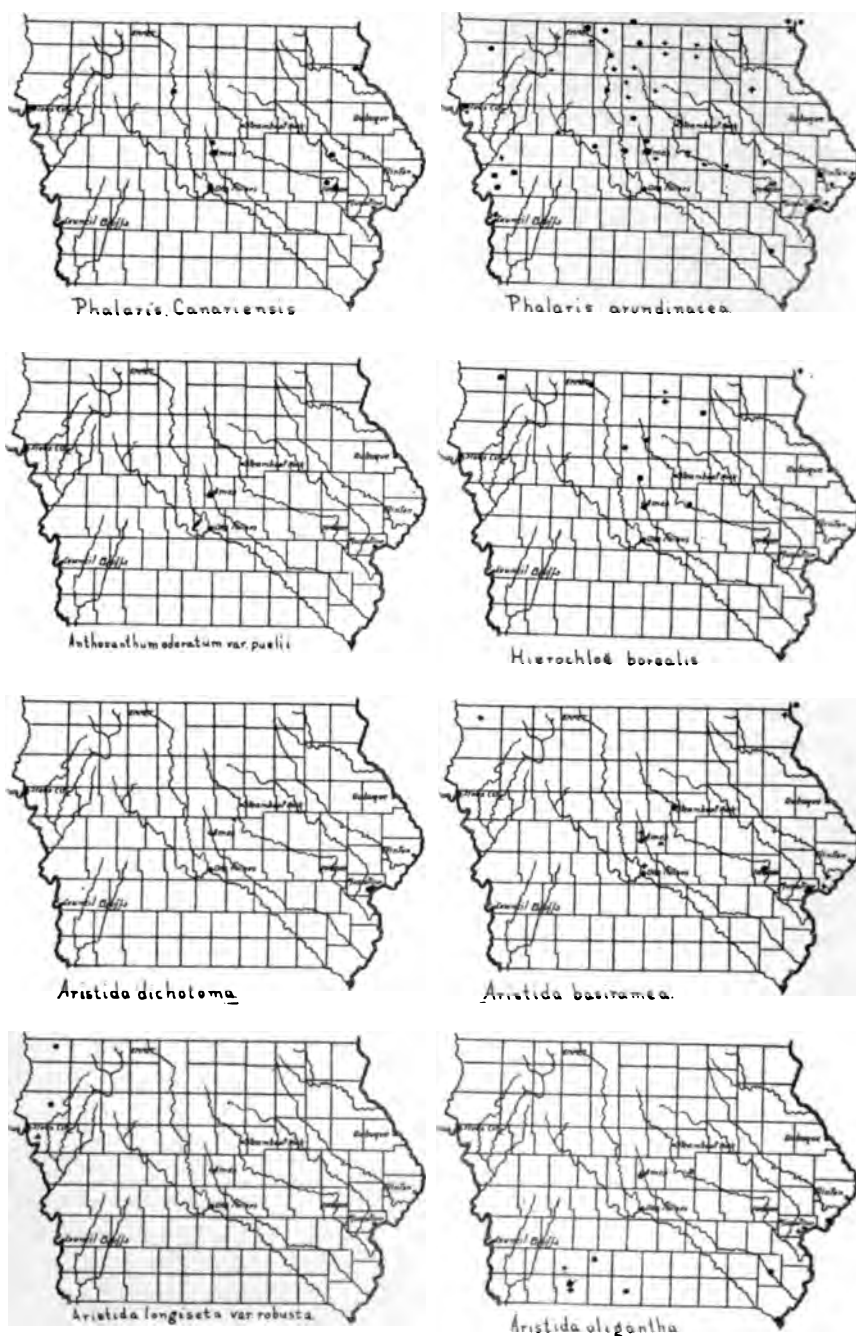


FIG. 73. Distribution of *Phalaris*, *Anthoxanthum*, *Hierochloa* and *Aristida*.
 • Specimens in herbarium. + From observation.

3. ORYZA.

Oryza. L. Sp. Pl. 333. 1753. Endlicher. Gen. Pl. 78. Bentham & Hooker Gen. Pl. 3: 1116. Hackel in Engler & Prantl. Nat. Pflanz Fam. II. 2: 41. f. 37. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 49. f. 34. *Pudra*. Zoll. & Mor. Verz. Pl. Zoll. 103.

DESCRIPTION.

Spikelets 1-flowered, hermaphrodite, strongly flattened laterally, in terminal panicles; rachilla articulated below the empty glumes. Glumes 3, the first two small, empty; the third compressed, keeled, somewhat rigid, usually awned. Palea 1-nerved, narrower, but about the length of the glume. Stamens 6. Grain oblong, obtuse, closely enveloped by the fruiting glume. Aquatic grasses with flat leaves and terminal panicles.

About twenty species have been described; the number has been reduced to six by Hackel. Found chiefly in the tropical regions of both hemispheres; India and China. Cultivated rice (*Oryza sativa*) has been in cultivation in China since ancient times; introduced into southern Europe by the Arabs; cultivated in the Carolinas since the seventeenth century. In addition to its culture in the West Indies and South America, it is also cultivated in the Philippines. It is the most important cereal of China, Japan and India. The upland rice is grown farther north than the other type, which needs a great deal of water to produce the best crops.



FIG. 74. *Oryza sativa*. (After Nees-Hackel.)

TRIBE VII. PHALARIDEAE.

Spikelets more or less laterally compressed, one or rarely three-flowered; glumes five, the first two empty and below the articulation of

1. PHALARIS CANARIENSIS

Phalaris Canariensis L. Sp. Pl. 54. 1753. Watson and Coulter, Gray. Man. Bot. 639. 1890. (6th ed.) Scribner Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 61. f. 69. 1894. Beal. Grasses of N. A. 2: 182. 1896. Nash in Britton and Brown. Ill. Fl. 1: 131. f. 292. 1896.

DESCRIPTION.

CANARY GRASS. An erect annual, 1 to 3 feet (2-6 dm.) high, with flat leaves, and a dense, ovoid panicle (head) about 1 inch (2 cm.) long, empty glumes with a broad, sharp keel, with a distinct, green line within the white, scarious margins. Third and fourth glumes small, scale-like, smooth. Fifth, or flowering glume, hairy. In waste places. July to August.

Phalaris Canariensis has become naturalized in Cedar Rapids and at a few other points in Iowa. The seed is used extensively for bird seed

DISTRIBUTION.

Iowa. Iowa City, Story City, Sioux City (Hitchcock); Giard (Hempel); Ames 136 (Ball); Dakota City (McFarland); Johnson County (Fitzpatrick); Des Moines 29 (Ball); Sioux City (Miss Wakefield); Cedar Rapids (Miss Hall); Ames (Pammel); Johnson County (Hitchcock).



FIG. 76. *Phalaris Canariensis*. (Charlotte M. King.)

North America. In waste places; New England to Texas, Alabama, Tennessee, California (San Diego, Orcutt), Nebraska, Wisconsin and eastward; Canada, Nova Scotia to Ontario, Vancouver Island.

General. Warm and temperate regions of Europe, North Africa and western Asia.

2. PHALARIS ARUNDINACEA.

Phalaris arundinacea L. Sp. Pl. 55. 1753. Watson and Coulter. Gray Man. Bot. 639. *pl. 13. f. 1-2.* 1889. Nash in Britton and Brown. Ill. Fl. 1: 130. *f. 290.* Beal. Grasses N. Am. 2: 183. Scribner. Grasses Tenn. Bull. Univ. of Tenn. Agrl. Exp. Sta. 7: 62. *pl. 18. f. 70.* Bull. U. S. Dept. Agrl. Div. Agros. 17: 115. *f. 411.* Vasey Contr. U. S. Nat. Herb. 3: 42.

DESCRIPTION.

REED CANARY GRASS.

A stout, erect, glabrous, broad-leaved perennial, 2 to 5 ft. (6-15 dm.) high, with densely flowered panicles, $2\frac{1}{2}$ to $6\frac{3}{4}$ inches (6-16 cm.) long. Spikelets $\frac{1}{4}$ inch (5-6 mm.) long, with scabrous, 3-nerved, outer glumes one-fourth longer than the obtuse, pubescent, flowering glume. June to August.

DISTRIBUTION.

Iowa. Hull (Newell); Boone (Carver); Mt. Pleasant 1352 (Ball); Story City 964 (Pammel and Stewart); Mt. Pleasant 20 (Ball); Elmore, Minn., Minnesota-Iowa line 907 (Pammel); Humboldt (Harvey); Slater 882, Missouri: Valley 1045, Jefferson (Pammel); Mt. Pleasant 771 (Mills); Armstrong (Cratty); Ames (Sirrine); Muscatine (Reppert); Sioux City (Miss Wakefield); Hamilton County (P. H. Rolfs);



FIG. 77. *Phalaris arundinacea*.—*a*, spikelet; *b*, outer glumes; *c*, flower with hairy rudiments. (Div. Agros. U. S. Dept. of Agrl.)

Woodbine (Burgess); Algona (Hitchcock); Wheatland 277 (Ball); Forest City 151 (Shimek); Armstrong 1063 (Cratty); Harrison County (Burgess); Kossuth County (Hitchcock).

North America. From New England to New York, Maryland (Echo, Kearney), Massachusetts (Pammel), Tennessee, Kansas, Mexico, Utah, Colorado (Ft. Collins, Crandall; Weld County, Pammel; Trinidad, Tracy), Wyoming (Hot Springs, A. and E. Nelson; Big Horn, Pammel), California; Nebraska (Grand Island, Pammel 25), Dakotas (S. D. Aberdeen, Griffith), Minnesota (Itaska Lake, Sandberg), Michigan, Wisconsin (La Crosse, Pammel 18), Ohio (Columbus, Sullivan; Lancaster County), Canada (Ottawa River, Beardslee).

General. Great Britain, on the continent of Europe, temperate and arctic regions, to Asia and Kurile Islands.

2. ANTHOXANTHUM.

Anthoxanthum L. Sp. Pl. 28. 1753. Bentham and Hooker. Gen. Pl. 3: 1138. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 43. f. 41. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20. 55. f. 37. Steudel. Syn. Pl. Glum. 1: 12

Spikelets hermaphrodite, 1-flowered, narrow, somewhat compressed. Glumes 5, the first and second empty, unequal, awnless or mucronate-pointed; the third and fourth empty, shorter, two-lobed, clothed with brown hairs, and awned below on the back; fifth shorter than the others, hyaline, broadly obtuse, awnless. Palea narrower, 1-nerved, included within the fifth glume. Stamens two. Styles distinct. Grain oblong, inclosed within the fifth glume, and palea, free. Aromatic, annual or perennial grasses, with flat leaves and narrow, spike-like panicles.

Living species, according to Bentham and Hooker, 4 or 5. Hackel states 4, and Scribner 3 or 4. Found in north temperate and cold regions of the old world. The best known member of the genus is sweet vernal grass (*Anthoxanthum odoratum*). (Name referring to the yellow hue of the spikelets in some species.)

ANTHOXANTHUM ODORATUM.

Anthoxanthum odoratum L. Sp. Pl. 28. 1753. Watson and Coulter. Gray. Man. Bot. 639. pl. 13. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 62. f. 71. 1894. Scribner. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 7: 88. f. 32. 1900. (3d ed.) Reel. Grasses of N. A. 2: 184. 1896. Nash in Britton and Brown. Ill. Fl. 1: 131. f. 293. 1896. Vasey Contr. U. S. Nat. Herb. 3: 43.



FIG. 78. *Anthoxanthum odoratum*. — a, spikelet; b, same with outer glumes removed; c, flowering glumes enclosing the stamens and pistil. (Div. of Agros. U. S. Dept. Agri.)

DESCRIPTION.

SWEET VERNAL GRASS. A sweet-scented grass, with slender, erect, tufted culms, flat leaf-blades, and narrow, **spike**-like, terminal panicles, $\frac{3}{4}$ to 4 inches (2-10 cm.) long. Spikelets 3 to 4 lines (6-8 mm.) long, the **very** unequal outer glumes enclosing the two-lobed and awned inner pair, which exceed the broadly **truncate** and short, flowering glume. Abundantly naturalized in lawns, fields and waysides. May to September.

All the specimens we have found in Iowa are referable to the variety. This species may, however, occasionally occur in lawns. Very fragrant in drying.

ANTHOXANTHUM ODORATUM, VAR. PUELII.

Anthoxanthum odoratum L. var. *puelii*, Lecoq. and Lamotte Cat. Pl. Auver. 385.

Anthoxanthum odoratum L. var. *puelii*, Beal. Grasses of N. A. 2: 185. 1896.

DESCRIPTION.

SWEET VERNAL GRASS. An annual, $7\frac{1}{2}$ to 20 inches (15-40 cm.) high. Smaller and more slender than the species, with shorter leaves. Spikes $1\frac{1}{4}$ inches ($2\frac{1}{2}$ cm.) long; second, lower, empty glume, when closed, linear-lanceolate, when spread, about two-thirds as wide as the corresponding glume of *A. odoratum*; third and fourth glumes narrower, darker and closed; lower part of the twisted awn almost black. June to August.

This grass is not abundant. It is found here and there along the borders of roadsides, in parks and public grounds or in lawns. Introduced with lawn mixtures. It seldom persists more than a season or two. Fragrant in drying.

DISTRIBUTION.

Iowa. Ames (Beardslee).

North America. Species naturalized in eastern North America and along the Pacific coast. Vermont, Massachusetts to New Jersey, and south to Alabama.

General. Europe, Asia and naturalized in Australia.

3. HIEROCHLOE

Hierochloe Gmelin Fl. Sib. 1: 100. 1747. Endlicher. Gen. Pl. 18. Bentham and Hooker. Gen. Pl. 3: 1139. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 44. f. 42.

Dimeria. Raf. Jr. Phy. 89. pl. 12 f. 7.

Disarrenum Labill. Pl. Nov. Holl. 2: 82. 1806.

Torresia Ruiz and Pav. Prod. Fl. Per. and Chill. 125. 1794.

Savastana Schrank. Baier. Fl. 1: 100. 337. 1789.



FIG. 79. *Anthoxanthum odoratum* var. *puelii*.—a, spikelet; b, awned glume; c, awnless glume; d, same with outer glumes removed. (Charlotte M. King.)

Spikelets 3-flowered, open-panicked, the two lower (lateral) flowers staminate only, 3-androus, sessile, the carinate glumes often awned on the middle of the back, or near the tip, the uppermost flower perfect, short-pedicelled, scarcely as long as the others, 2-androus, awnless. Basal glumes persistent, carinate, acute, somewhat 3-nerved, equalling or exceeding the spikelet. Perennials; leaves flat. (Name from two Greek words for *sacred* and *grass*; these sweet-scented grasses being strewn before the church doors on saints' days, in the north of Europe.)

According to Bentham & Hooker there are 8 living species; Hackel

recognizes 13, of which 5 occur in Europe, 5 in Russia; North America is credited with 5 by Heller, and Beal recognizes 5; one species is found in Mexico, one in California, and one in the Rocky Mountains.

HIEROCHLOE BOREALIS.

Hierochloe borealis Roem and Schultes Syst. 2: 513. 1817. Watson and Coulter. Gray. Man. Bot. 639. *pl.* 13. 1890. (6th ed.). Vasey Contr. U. S. Nat. Herb. 3: 43.

Holcus fragrans Willd. Sp. 4: 936. 1805.

Holcus odoratus L. Sp. Pl. 1048. 1753.

Savastana odorata Scribn. Mem. Torr. Bot. Club. 5: 34. 1894.

Savastana odorata (L.) Scribn. Beal. Grasses of N. A. 2: 186. 1896. Nash in Britton and Brown, Ill. Fl. 1: 132. *f.* 294. 1896. Scribner, Bull. U. S. Dept. Agr. Div. Agros. 7: 83. *f.* 83. 1900. (3d ed.)

DESCRIPTION.

VANILLA GRASS. A slender, sweet-scented, stoloniferous perennial, 1 to 2 feet (3-6 dm.) high, with short culm leaves, and brownish, open panicles, $1\frac{1}{2}$ to 4 inches (4-10 cm.) long, branches in pairs. Spikelets yellowish-brown and purple, 2 to 3 lines (4-6 mm.) long; the first and second glumes thin, subequal, glabrous; the third and fourth hairy and awn-pointed, the fifth hairy at the apex and enclosing a perfect flower. The flat leaves of the sterile shoots are 4 to 12 inches (1-3 dm.) long. May to August.

Hierochloe borealis is common in low, marshy grounds in northern Iowa, nearly as far south as Grinnell, northward and through Marshall County to Hamilton County, northwest. The sweet odor of the grass is due to cumarin.



FIG. 80. *Hierochloe borealis*.—a, spikelet with nearly equal lower glumes; b, with lower glumes removed, showing third and fourth scabrous glumes; c, palea with stamens; d, pistil. (Div. of Agros. U. S. Dept. of Agr.)

DISTRIBUTION.

Iowa. Charles City (Arthur); Marshalltown, 17 (Ball and Combs); Armstrong, 1075, Emmet County (Cratty); Ames (Beardslee); Jewell Junction, 1169 (Stewart); Eagle Grove, 1170 (Stewart); Little Rock (Miss Bowen).

North America. From New England to New York, Massachusetts (Cambridge, Pammel), New Hampshire (Mt. Washington, Flint and Huntington); west to Illinois, Michigan, Wisconsin (Madison, Pammel), Ohio (Columbus, Sullivant), Colorado (La Poudre River, 8500 ft., Pammel), Utah (Provo River, Pammel and Stanton), Montana, Wyoming (Clear Creek, Griffith; Sheridan County, Dome Lake, Pammel, 83; Rapid Creek Park, Pammel, 82), Alaska; from Newfoundland, Labrador to New Brunswick, Quebec and Ontario. Manitoba north to Pease River, and Columbus Valley to 62 degrees north latitude.

General. Great Britain, Arctic and Alpine northern Europe, northern and western Asia.

TRIBE VIII. AGROSTIDEAE.

Spikelets all hermaphrodite, 1-flowered with three glumes, the first two empty (very rarely wanting), usually as long as or exceeding the third or floral glume; rachilla sometimes prolonged behind the palea into a naked or plumose bristle. Palea two-nerved (one-nerved in *Cinna*), nerveless, or (in some *Agrostis* species) wanting.

The tribe Agrostideae is an important one, numbering about 700 species arranged in 46 genera. They occur throughout the temperate and warmer regions of the world, some occurring within the tropics. The genus *Agrostis* (Red Top), and the genus *Phleum* (Timothy), are the best known representatives of the tribe. Some members of the genus are injurious to live stock, like *Aristida* and *Stipa*.



FIG. 81. Spikelet of *Agrostis alba*, sterile lower glumes, flowering glume, palea, stamens and stigmas. (Adapted from Gray's *Man.*)

KEY TO THE GENERA OF THE AGROSTIDEAE.

- Flowering glume indurated at maturity, firmer in texture than the empty glumes, very closely enveloping the grain, awn, when present, terminal.
 Rachilla not prolonged behind the palea.
 Flowering glume with a trifid awn..... *Aristida*.¹
 Flowering glume with a simple awn.
 Flowering glume narrow.

ing; leaves narrow, often involute. Spikelets in simple or paniced racemes or spikes. Grain linear. All grow in sterile, dry soil, and all of ours have the awns naked and persistent, and flower late. (Name from *arista*, a beard or awn.)

About 100 species in the warmer regions of both hemispheres. Eastern North America 12; Europe 2; North America 36-38; southern states 17; Canada 4; Alabama 8; Texas 20; Iowa 8.

KEY TO THE SPECIES OF ARISTIDA.

Awns not articulated with the glumes.

Central awn coiled at the base.

Spikelet about 6 mm. long, empty glumes nearly equal.

—*A. dichotoma*.¹

Spikelet about 10 mm. long, first empty glume much shorter.

—*A. basiramea*.²

Central awn not coiled at the base.

First empty glume much shorter than the second, central awn 6-10 cm. long.

Empty glumes acute or mucronate.....*A. longiseta*.³

Empty glumes cleft and awned.....*A. longiseta* var. *robusta*.⁴

First empty glume nearly equalling or exceeding the second.

Spikelets more than 2 cm. long, first glume 5-7 nerved

—*A. oligantha*.⁵

Spikelets 8-10 mm. long.....*A. intermedia*.⁶

Spikelets about 6 mm. long.....*A. gracilis*.⁷

Awns articulated with the glume, united at the base into a spiral

column.....*A. tuberculosa*.⁸

1. ARISTIDA DICHOTOMA.

Aristida dichotoma Michx. Fl. Bor. Am. 1: 41. 1803. Watson and Coulter. Gray. Man. Bot. 640. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 64. f. 73. 1894. Scribner. Bull. U. S. Dept. Agrl. Div. Agros 17: 118. f. 414. 1900. Vasey Contr. U. S. Nat. Herb. 3: 44. Beal Grasses of N. A. 2: 208. 1896. Nash in Britton and Brown. Ill. Fl. 1: 133. f. 297. 1896.

Aristida dichotoma var. *Curtissii*. A. Gray. Man. 640. (6th ed.)



FIG 82. *Aristida dichotoma*.—a, lower or empty glumes of a spikelet; b, a floret showing awns, middle one coiled. (Div. Agros. U. S. Dept. Agrl.)

DESCRIPTION.

POVERTY GRASS. A low, much branched annual, 6 to 24 inches ($1\frac{1}{2}$ -6 dm.) high, with few-flowered, spike-like, simple panicles, 1 to 4 inches (2-8 cm.) long; ligule a minute fringe of hairs; leaf-blade very narrow involute, 1 to 6 inches (2-12 cm.) long. Spikelets erect, 3 to 4 lines (6-8 mm.) long; empty glumes nearly equal, linear, the upper often mucronate-pointed, equalling, or more often exceeding, the flowering glume; flowering glume with minute, appressed hairs on the back, three awned, the lateral awns very short and erect, the middle one soon reflexed and flexuose at the base. Callus hairy. Not widely distributed in this state, chiefly in southeastern Iowa. August to September.

DISTRIBUTION.

Iowa. Muscatine (Reppert).

North America. New England, New York, Pennsylvania, New Jersey to Florida; D. C. (Williams); Ohio (Sullivant); Tennessee (Scribner), Missouri (Eggert).

2. ARISTIDA BASIRAMEA.

Aristida basiramea Engelm. Vasey. Bot. Gaz. 9: 76. 1884. Watson and Coulter. Gray Man. Bot. 640. 1890. (6th ed.). Vasey Contr. U. S. Nat. Herb. 3: 44. Nash in Britton and Brown. Ill. Fl. 1: 134. f. 299. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 119. f. 415. 1899.

Aristida basiramea Vasey. Beal. Grasses N. A. 2: 200. 1896.

DESCRIPTION.

TUFTED TRIPLE AWN GRASS. An erect, slender, smooth, much-branched perennial, 5 to 20 inches (1-4 dm.) high, with narrow, involute-setaceous leaves, and few-flowered, spike-like panicles, 2 to 3 inches (.5-.75 dm.) long. Empty glumes unequal middle awn 6 to 9 lines (12-18 mm.) long, coiled at base and divergent. Common on gravelly knolls in northern, central and eastern Iowa. August to September.



FIG. 83. *Aristida basiramea*—a, empty glumes; b, flowering glume. (Div. Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. Muscatine (Reppert); Muscatine, 1238 (Pammel and Reppert); Ames, 174 (Hitchcock, Pammel); Iowa City (Hitchcock,

Macbride), Steamboat Rock (Shimek).

North America. Illinois, Wisconsin (La Crosse, Pammel), Minnesota, Iowa, Missouri (Eggert), Nebraska, Colorado and Wyoming (Griffith).

3. *ARISTIDA LONGISETA.*

Aristida longiseta Steud. Syn. Pl. Glum. 1: 420. 1855. Merrill. Circ. U. S. Dept. Agrl. Div. Agros. 34: 3.

Aristida fasciculata Nuttall. Thurb. Beal Grasses N. A. 2: 208. 1896.

DESCRIPTION.

PURPLE ARISTIDA. A densely tufted, glaucous, glabrous perennial; culms 4 to 18 inches (1-4 dm.) tall, erect, slender, smooth or rough, usually with purplish setae and with numerous, involute basal leaves.

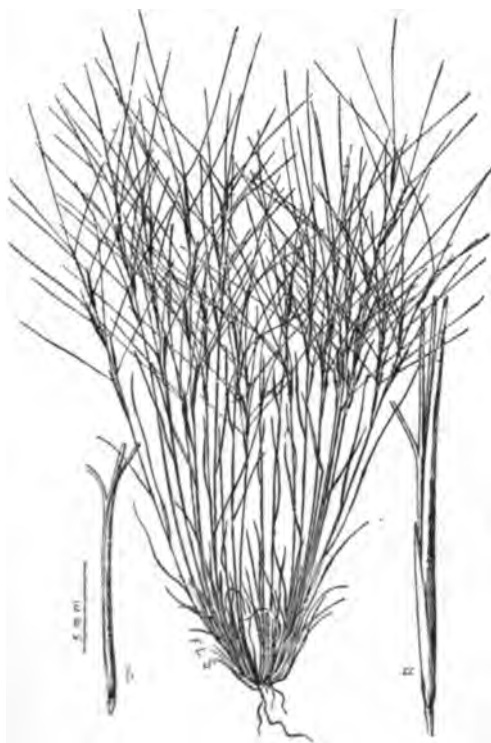


FIG. 84. *Aristida longiseta*—a, spikelet; b, flowering glume. (Div. Agros. U. S. Dept. Agrl.)

Sheaths shorter than the internodes, smooth or slightly scabrous; ligule short with a ciliate fringe; leaves 1 to 5½ inches (2-11 cm.) long, ½ line (1 mm.) wide, involute, at least when dry, usually scabrous. Panicle few flowered, exserted, the branches solitary or two or three at the lower nodes, ascending; spikelets rather large, purplish, lower empty glume one-nerved or sometimes with an obscure additional nerve on each side; empty glumes unequal, the first shorter than the flowering glume, slightly scabrous on the keel, acute or with a very short, mucronate tip, 11 mm. long; second glume much exceeding the flowering glume, about 20 mm. long, otherwise much as the first; flowering glume 6 lines (12 mm.) long, including the densely pubescent callus, which is about 1 mm. long, smooth below, scabrous above. Setae nearly equal, scabrous, about 3 inches (7 cm.) long. July to September.

This grass is found in northwestern Iowa from Lyon to Dickinson counties. It is rare or local here.

DISTRIBUTION.

Iowa. Probably with the variety.

North America. Minnesota, Iowa, north to Saskatchewan and British Columbia, southwest to Kansas, Texas, Arizona, Colorado (Ft. Collins, Crandall; La Porte, Golden and Denver, Pammel), Wyoming (New Castle, Pammel), Nebraska (Alma, Grand Island, North Platte, McCook, Pammel).

4. *ARISTIDA LONGISETA* VAR. *ROBUSTA*.

Aristida longiseta robusta Merrill. Circ. U. S. Dept. Agrl. Div. Agros. 34: 5.



FIG 15. *Aristida longiseta* var. *robusta*. a, and c, sterile outer glumes; b, flower showing the spreading awns. (Charlotte M. King.)

DESCRIPTION.

LARGE PURPLE ARISTIDA. A stout, densely tufted form, 1-1½ feet (3-4 dm.) high, with robust culms, more rigid inflorescence and usually longer leaves than in the species. Empty glumes as in the species, except that both are prominently cleft at the apex, bearing in the cleft a scabrous awn about 1 line (2 mm.) long; flowering glume nearly smooth or only slightly scabrous. Dry soils July-September.

DISTRIBUTION.

Iowa. Plymouth County (Leiberg), Rock Rapids (C. R. Ball).

North America. From South Dakota to Kansas and Washington and British Columbia.

5. *ARISTIDA OLIGANTHA*.

Aristida oligantha Michx. Fl. Bor. Am. 1: 41. 1803. Watson and Coulter. Gray. Man. Bot. 640. 1890. (6th ed.). Scribner, Grasses of Tenn. Bull. Univ.

Tenn. Agrl. Exp. Sta. 7: 65. f. 77. 1894. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 17: 122. f. 418. 1899. Beal. Grasses of N. A. 2: 202. 1896. Nash in Britton and Brown. Ill. Fl. 1: 135. f. 303. 1896. Vasey Contr. U. S. Nat. Herb. 3: 46.

DESCRIPTION.

PRAIRIE TRIPLE AWN. A tufted annual, with slender branching culms, 6 to 12 inches (15-30 cm.) high, narrow leaves, and loosely few-flowered racemes. Sheaths smooth; ligule a fringe of short hairs; leaf-blade 2 to 6 inches (5-15 cm.) long, involute, filiform, at least when dry. Panicle racemose, four to six-flowered. Spikelets 9 to 11 lines (18-22 mm.) long (exclusive of the awns); empty glumes three to five-nerved, subequal, a little shorter than the flowering glume, more or less awn-pointed; flowering glumes scabrous, at least above, three-awned, awns nearly equal, or the lateral a little shorter, divergent, 1 to 2 inches (2-5 cm.) long. Callus soft-hairy, acute. Dry, gravelly or sterile soil. Chiefly in southeastern Iowa but also found locally in the central portion. July to October.



FIG 81. *Arisida oligantha* a. the lower or empty glume; b. flower with widely spreading awns. (Div. Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. West Davenport, 130 (Barnes and Miller); Mt. Pleasant (Mills); Keokuk (P. H. Rolfs); Ames (Pammel); Decatur County (Fitzpatrick), Creston (Ashby).

North America. New Jersey to Maryland, and west to Nebraska, Iowa, Missouri (Eggert; Forest Park, Pammel), and south to Louisiana and Texas.

6. ARISTIDA INTERMEDIA.

Aristida intermedia. Scrib. and Ball. Bull. U. S. Dept. Agr. Div. Agros. 24: 44.

DESCRIPTION.

INTERMEDIATE ARISTIDA. A slender, somewhat geniculate, branching annual, 1 to 2½ feet (3-7 dm.) high, with involute leaves and long slender, panicles. Culms smooth, freely branching, purplish, the outer branches geniculate, ascending; sheaths usually shorter than the internodes, smooth or the lower sparsely hirsute, especially on the margins, and purplish; ligule a very short ring, .2 lines (0.4 mm.) long or less, fringed with short hairs; blades 1½ to 5 inches (5-15 cm.) long, 1 line (2 mm.) wide, erect, rigid, involute, sometimes sparsely hirsute near the base. Panicle, ¾ to 1½ feet (2-4 dm.) long, slender, often flexuose; branches short, ¾ to 1½ inches (2-4 cm.) long, appressed. Spikelets, 4 to 5 lines (8-10 mm.) long; empty glumes narrowly lanceolate, attenuate into a rather long awn, nearly equal or the upper longer, 3½ to 4½ lines (7-9 mm.) long, 1-nerved, scabrous, purplish; flowering glume 3½ to 4½ lines (7-9 mm.) long, strongly scabrous above the middle, equalling or exceeding the empty glumes, sometimes regularly spotted as in *A. gracilis*; awns all spreading, the middle one 9 to 11 lines (18-22 mm.) long, the lateral ones 7 to 8 lines (14-17 mm.) long, all variable. This species is most closely allied to *A. gracilis*, but differs in its larger size, and especially in the much longer florets and awns. It is nearly intermediate between *A. gracilis* and *A. purpurascens*, with the habit of the former and spikelets more like those of the latter.



FIG. 87. *Aristida intermedia*—a, spikelet. (Div. Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. Wapsipinicon River (31, E. N. Wilcox).

North America. Iowa to Texas and Mississippi.

7. ARISTIDA GRACILIS.

Aristida gracilis Ell. Bot. S. C. and Ga. 1: 142. 1817. Watson and Coulter. Gray. Man. Bot. 640. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 64. f. 74. 1894. Beal. Grasses N. A. 2: 209. 1896. Nash in Britton and Brown, Ill. Fl. 1: 133. f. 298. 1896. Vasey Contr. U. S. Nat. Herb. 3: 44.

Aristida gracilis var. *depauperata*. A. Gray. Man. 618. 1867. (5th ed.)

DESCRIPTION.



FIG. 88. *Aristida gracilis*. Upper right hand figure spikelet. (Charlotte M. King.)

the divaricate or reflexed middle one. Callus hairy. In sandy, gravelly or poor soils. September-October.

SLENDER ARISTIDA. A slender, erect grass, 12 to 24 inches (24-48 cm.) high, branched near the base, the culms and branches terminating in slender, rather densely-flowered, racemose or spike-like panicles 3 to 7 inches (6-14 cm.) long. Rays of the panicle in pairs, erect, one to several-flowered. Sheaths smooth or pilose near the base; ligule a minute fringe of short hairs; leaf-blade 3 to 5 inches (6-11 cm.) long, about 1 line (2 mm.) wide, soon convolute. Spikelets 2 to 3 lines (4-6 mm.) long (exclusive of the awns); empty glumes one-nerved, narrowly lanceolate, nearly equal, or the lower one a little shorter than the upper which is usually short awned or mucronate-pointed; flowering-glume usually a little longer than the empty ones, rough and usually spotted on the back, three-awned, the lateral awns straight and one-third to one-half the length of the middle one. Callus hairy. In sandy, gravelly or poor soils. September-October.

DISTRIBUTION.

Iowa. Keokuk (Hitchcock).

North America. Southern New England, New York, New Jersey, Pennsylvania to Florida; west to Georgia (Kearney) and Louisiana (Ball); Texas (Blackshear, Pammel), north through Arkansas, Kentucky (Kearney), Missouri (Eggert), Iowa.

8 ARISTIDA TUBERCULOSA.

Aristida tuberculosa Nutt. Gen. 1: 57. 1818. Watson and Coulter. Gray Man. Bot. 641. 1890. (6th ed.) Beal. Grasses N. A. 2: 196. f. 40. 1896. Nash in Britton and Brown. Ill. Fl. 1: 136. f. 307. 1896. Scribner. Bull. U. S. Dept. Agri. Div. Agros. 7: 94. f. 88. 1900. (3d ed.) Vasey Contr. U. S. Nat. Herb. 3: 48.

DESCRIPTION.

LONG AWNED POVERTY GRASS. A rigid, much-branched perennial, 12 to 18 inches (3-4½ dm.) high, with nearly simple panicles, 4 to 7 inches (10-18 cm.) long, branches erect, rather distant, the lower in pairs, one short and few-flowered, the other elongated and many-flowered. Empty glumes nearly equal, 12 lines (24 mm.) long, awn-pointed; flowering glume about 10 lines (20 mm.) long, twisted above to the division of the awns, and with a densely barbate, sharp-pointed calus; awns nearly equal, divergent or reflexed, 1½ to 2 inches (3-5 cm.) long, distinctly articulated with the glume. August to October.



FIG. 89. *Aristida tuberculosa*—a, spikelet with lower glumes; b, flowering glume with divergent, long awns.

DISTRIBUTION.

Iowa. Muscatine (Reppert).

North America. Sandy beaches and sandy soil. Massachusetts to Wisconsin (La Crosse, Pammel), Illinois, Minnesota, Iowa and Georgia.



FIG. 90. *Aristida tuberculosa*, *purpurea* and *oligantha*. Three species of *Aristida* showing spikelets. (From photograph.)

2. STIPA.

Stipa L. Sp. Pl. 78. 1753. Endlicher Gen. Pl. 88. Bentham and Hooker Gen. Pl. 3: 1141. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 46. f. 44 Scribner. Bull. U. S. Dept. Agr. 20: 62. f. 40.

Macrocloa Kunth. Rev. Gram. 1: 58. 1835.

Aristella Bertol. Fl. Ital. 1: 690. 1833.

Streptachne R. Br. Prod. 174. 1810.

Jarava Ruiz and Pav. Prod. Fl. Per. 2: Pl. 1. 1794.

Lasiagrostis Link. Hort. berol. 1: 99. 1827.

Orthoraphium Nees. Proc. Linn. Soc. 1: 94. 1841.

Achnatherum Beauv. Agros. 19. 1812.

Ptilagrostis Griseb in Led. Fl. Ross. 4: 447. 1853.

Spikelets 1-flowered, terete; the flower falling away at maturity. (with the conspicuous, obconical, bearded and often sharp-pointed callus) from the membranaceous, persistent, lower glumes. Fertile glumes coriaceous, cylindrical-involute, and closely embracing the smaller palea and the cylindrical grain, having a long and twisted or tortuous, simple awn jointed with its apex. Stamens mostly 3. Stigmas plumose. Perennials, with narrow, involute leaves and a loose panicle. (Name from the Greek word for *tow* in allusion to the flaxen appearance of the feathery awns of the original species. In our species the awn is naked.)

Species about 100 according to Bentham & Hooker and Hackel. Found chiefly in the tropics, generally in savannas, steppes and prairie regions. In southern and central Europe to Russia; Asia, North and South America, Africa and Australia.

KEY TO THE SPECIES OF STIPA.

Empty glumes less than 10 mm. long.....*S. viridula*.¹
Empty glumes over 15 mm. long.

Base of panicle usually included in upper sheath; flowering glume 8-12 mm. long; awn slender, curled.....*S. comata*.²

Panicle wholly exerted, flowering glume 14-24 cm. long; awn stout, bent.....*S. spartea*.³

1. STIPA VIRIDULA.

Stipa viridula Trin. Mem. Bull. Sc. Acad. St. Petersburg. VI. 2: 39. 1836. Beal Grasses N. Am. 2: 221. Watson and Coulter. Gray. Man. Bot. 642. 1890. (6th ed.) Nash in Britton and Brown. Ill. Fl. 1: 138. f. 310. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 134. f. 430 1899. Vasey Contr. U. S. Nat. Herb. 3: 50. in part.



FIG 91 *Stipa viridula*—a, outer or lower glumes; b, sharp pointed callus of the flower. (Div. Agros. U. S. Dept. Agr.)

Stipa spartea Hooker Fl. Bor. Am. 2: 237. 1840. (Not of Trinius.)

DESCRIPTION.

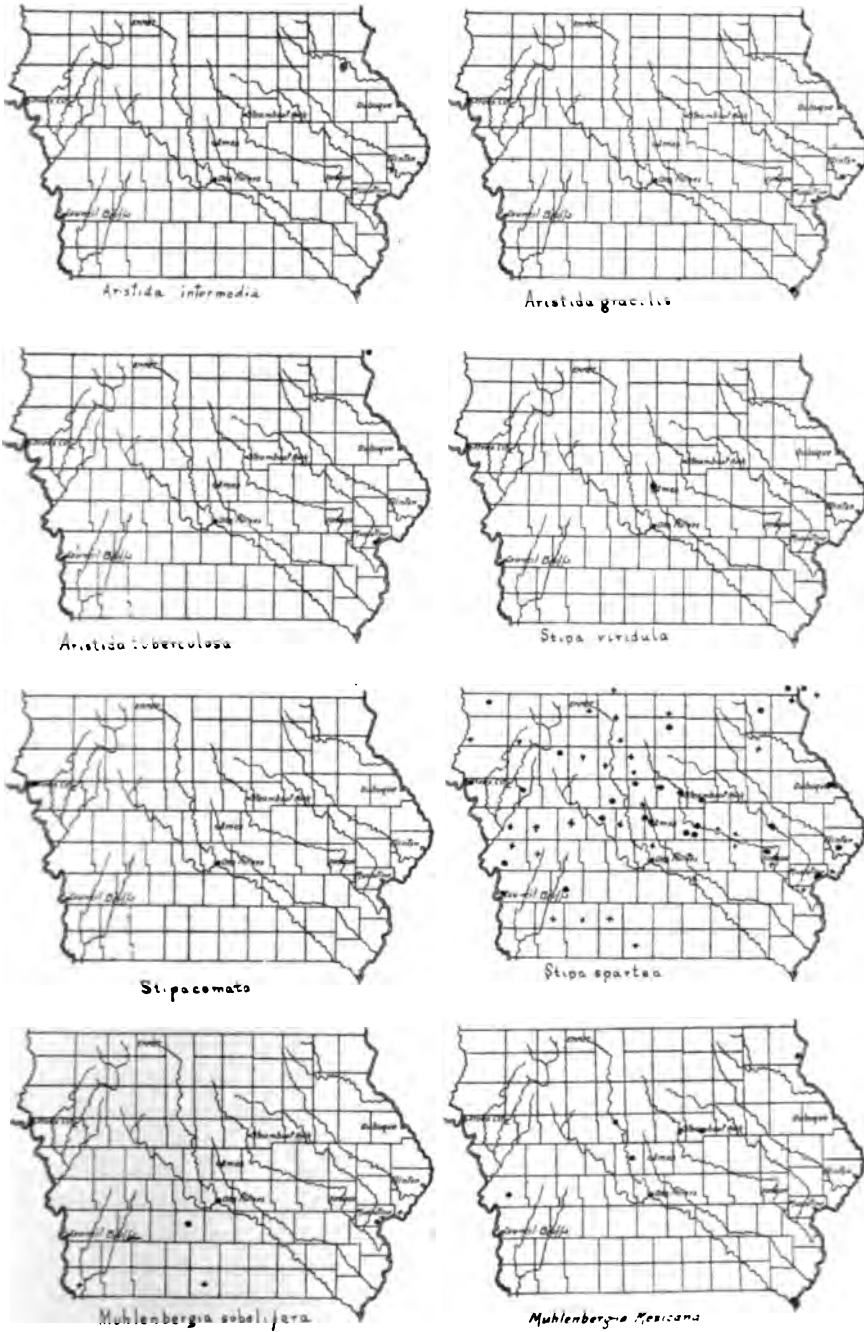
GREEN STIPA. FEATHER BUNCH GRASS. A slender or rather stout, caespitose perennial, erect panicles, $2\frac{1}{2}$ to 5 feet (5-10 dm.) high, with involute-pointed leaves and narrow, contracted panicles 6 to 10 inches (12-20 cm.) long. Spikelets with nearly equal, subulate-pointed, empty glumes, 3 to $4\frac{1}{2}$ lines (6-9 mm.) long, and hairy or pilose flowering glume, which is about $2\frac{1}{2}$ lines (5 mm.) long, and has a short, obtuse callus. Awn about 12 lines (24 mm.) long, finally separating from the glume. June-August.

Feather bunch grass has been introduced in a few places along the railroads.

DISTRIBUTION.

Iowa. Ames (Sirriner, P. H. Rolfs, C. A. Wilson, E. R. Wilson, Pammel, Combs and Ball).

North America. Introduced into Iowa; from western Minnesota, Nebraska (Alma, Pammel, 161; McCook, Pammel, 375), south to Kansas and New Mexico, Colorado (Ft. Collins, Crandall, Pammel; Ouray, Shear, 1160; Greeley, Pammel; Leadville, Trelease); Utah (Uintah Mountains, Kamas, Pammel and Stanton, 220; Uintah Mountains, Mud Creek, Pammel, 916; West Duschene, Pammel, 217); Wyoming (Uintah Mountains, Fuller's Ranch, alt. 8,000 ft., 917, Pammel, Johnson, Buchanan and Lummis; Sheridan, Pammel; New Castle, Pammel, 3); Montana (Bonner, Sandberg, Heller and McDougal 986), and California. British Columbia to Manitoba.



● Specimens in herbarium. † Based on observations.

2. STIPA COMATA.

Stipa comata Trin. and Rupr. Mem. Acad. St. Petersburg. VI. 5: 75. 1842. Beal. Grasses of N. A. 2: 216. 1896. Nash in Britton and Brown. Ill. Fl. 1: 138. f. 312. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 129. f. 425. 1899. Vasey Contr. U. S. Nat. Herb. 3: 52



FIG. 93. *Stipa comata*—a, empty or lower glumes; b, pubescent flowering glume and pointed callus. (Div. Agros. U. S. Dept. of Agr.)

DESCRIPTION.

WESTERN STIPA. NEEDLE GRASS. A rather stout, erect, caespitose perennial, $1\frac{1}{2}$ to 4 feet (3-9 dm.) high, with mostly involute leaves, and loosely-flowered panicles, 8 to 12 inches (16 to 24 cm.) long. Spikelets with nearly equal, long-attenuate-pointed, empty glumes about 12 lines (24 mm.) long, and thinly pubescent flowering glumes about 6 lines (12 mm.) long. Awn slender, $2\frac{1}{2}$ to 3 inches (8-10 cm.) long, strongly flexuose or variously curled and twisted. May to September.

A rare species in Iowa, only reported from one locality, Sioux City by Miss Wakefield and Professor Hitchcock.

DISTRIBUTION.

Iowa. Sioux City (Hitchcock).

North America. From western Iowa, Dakotas (S. D., Edgemont, Stanton), Wyoming (Uintah Mountains, Mud Creek, 1542, Pammel, Johnson, Buchanan and Lummis; Sheridan County, Pammel, 160; New Castle, Pammel, 2; Sherman, Pammel, 2); Montana (Dillon, Shear, 334), Nebraska (McCook, Pammel, 383); Colorado (Ft. Collins, Crandall; La Poudre River, Pammel; Ft. Morgan, Pammel; Colorado Springs, Pammel, 223; Greenland, Pammel and Stanton);

Utah (Salt Lake, Pammel, 188); Oregon, Washington (Douglass County, Sandberg and Leiberg), California (Lemmon), and Arizona.

3. STIPA SPARTEA.

Stipa spartea Trin. Mem. Acad. St. Petersburg. VI. 1: 82. 1831. Watson and Coulter. Gray. Man. Bot. 641. 1890. (6th ed.) Beal. Grasses of N. A. 2: 215. 1896. Vasey. Contr. U. S. Nat. Herb. 8: 53. Nash in Britton and Brown. Ill. Fl. 1: 139. f. 313. 1896. Scribner. Am. Grasses. Bull. U. S. Dept. Agr. Div. Agros. 7: 95. f. 89. 1900. (3d ed.)

DESCRIPTION.

PORCUPINE GRASS. A stout, erect perennial, with simple culms 3 to 5 feet (6-10 dm.) high; long, narrow leaves and contracted, few-flowered panicles, 4 to 8 inches (10-20 cm.) long. Spikelets larger; empty glumes subulate-pointed, 12 to 18 lines (24-36 mm.) long, slightly unequal; flowering glume 8 to 10 lines (16-20 mm.) long, including the barbed and very sharp-pointed stipe or callus, sparsely pubescent below and crowned with a few short hairs; palea nearly as long as the glume; awn stout, 3 to 6 inches (8-15 cm.) long, twisted below and twice geniculate above. June to August.

Porcupine grass is common on dry, gravelly roads and high prairies.



FIG. 91. *Stipa spartea*—a, a single spikelet; b, floret more highly magnified, with sharp pointed bearded callus. (Div. Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. Winneshiek County, Shelby County (Fitzpatrick); Harcourt (Danielson); Alden (Stevens); 945, Battle Creek (Preston); Ames (Bessey, Carver, E. R. Wilson, 177 Ball, Weaver, Crozier, Sirrine 1147 and 1149, Louthan); Iowa City (Hitchcock); Jewell Junction (Carver); 3278, Ontario (Faurot); Marshalltown (Eckles); 530, Muscatine (Reppert); Sioux City (Miss Wakefield); Johnson County, Cedar Rapids, Lyon County (Shimek); Van Cleve (Warden); 3252, Grundy Center (Miss Paddock); 3052, Steamboat Rock (Miss King); 672 Missouri Valley, Council Bluffs, 1466 De Witt, 1429 Carroll, 1277 Council Bluffs, 1163 Ames, Dubuque (Pammel); Clear Lake (Shimek), 18 Marshall County (Ball), 3335 Marathon (Roberts).

North America. From Wisconsin (La Crosse, Pammel), Illinois, to Missouri, Kansas, Nebraska, Dakotas (S. D., Aberdeen, Griffith, 820; N. D., Fargo, Bolley), and Minnesota to New Mexico (Glorieta, Vasey), Manitoba to British Columbia.

3. MUHLENBERGIA.

Muhlenbergia Schreb. Gen. Pl. 44. 1789. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 47. f. 45. Bentham and Hooker Gen. Pl. 3: 1143. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 65. f. 43.

Muhlenbergia Schreb. Endlicher. Gen. Pl. 88.

Vaseya Thurb. Proc. Acad. Nat. Sc. Philad. 1863: 79. Watson Bot. Cal. 2: 278.

Podosoemum Desv. Nuov. Bull. Soc. Philom. 2: 188. 1813.

Calycodon Nutt. Jr. Acad. Philad. II. 1: 186. 1817.

Clomena Beauv. Agros. 28. pl. 7. f. 10. 1812.

Tosagris Beauv. Agros. 29. pl. 8. f. 3.

Spikelets 1-flowered, in contracted or rarely in open panicles. Empty glumes mostly acute or bristle-pointed, persistent, usually thin; the lower rather smaller or minute. Flower very short-stalked or sessile, the glume and palea usually minutely bearded at base, herbaceous, deciduous with the enclosed grain, often equal, the glume 3-nerved,

mucronate or awned at the apex. Stamens 3. (Dedicated to the *Rev. Dr. Henry Muehlenberg*, a distinguished American botanist of the early part of the last century.)

About 60 species according to Bentham and Hooker; the same number according to Hackel, of which Heller lists 37 species north of Mexico. Thirty-five species are reported for Mexico and Central America.

KEY TO THE SPECIES OF MUHLENBERGIA.

Flowering glume not awned, often acuminate.

Empty glumes acute, about $\frac{1}{2}$ as long as the flowering glume.

— *M. sobolifera*.¹

Empty glumes acuminate, about 3 mm. long, about equalling the flowering glume.....*M. mexicana*.²

Empty glumes awned, about 5 mm. long, nearly twice the length of the flowering glume.....*M. glomerata*.³

Flowering glume awned.

Awn usually twice the length of the glume.

Empty glumes minute.....*M. diffusa*.⁴

Empty glumes about one-half as long as flowering glume.

— *M. Wildenovii*.⁵

Empty glumes about equalling the flowering glume..*M. sylvatica*.⁶

Awn 3-4 times as long as the glume, second empty glume distinctly 3-awned, cultivated.....*M. gracilis*.⁷

1. MUHLENBERGIA SOBOLIFERA.

Muhlenbergia sobolifera Trin. Unifl. 189. 1824. Watson and Coulter. Gray. Man. Bot. 643. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 67. f. 82. 1894. Vasey Contr. U. S. Nat. Herb. 3: 68.

Muhlenbergia sobolifera (Muhl.) Trin. Beal. Grasses of N. A. 2: 244. 1896. Nash in Britton and Brown. Ill. Fl. 1: 142. f. 320. 1896.

Agrostis sobolifera Muhl. Willd.
Enum. 95. 1809.

DESCRIPTION.

ROCK MUHLENBERGIA. A slender perennial, with more or less branching, leafy culms 1 to 2 feet (3-6 dm.) high, from creeping, scaly rootstocks. Sheaths smooth or slightly scabrous; ligule very short; leaf-blade flat, 1 to 3 lines (2-6 mm.) wide, 3 to 5 inches (6-10 cm.) long, scabrous. Panicle 2 to 7 inches (4-16 cm.) long, filiform, with erect, appressed branches. Spikelets crowded, 1 line (2 mm.) long or less. Empty glumes ovate-lanceolate, acute, mucronate, or sub-aristate-pointed, nearly equal, one-fourth to one-half shorter than the flowering glume; flowering glume ovate-lanceolate, 3-nerved, short mucronate, scabrous on the back, short-pilose toward the base and on the callus; palea as long as the flowering glume. Rocky woods. September-October.



FIG. 95 *Muhlenbergia sobolifera*—a, spikelet; b, empty lower glume; c, flowering glume; d, palea; e, fruit. (Charlotte M. King.)

DISTRIBUTION.

Iowa. Winterset, 1103 (Carver); Muscatine (Pammel); Ft. Dodge (Oleson).

North America. Massachusetts south to Virginia, Texas, Illinois, Indiana, Missouri (Eggert), to southeastern Minnesota.

2. MUHLENBERGIA MEXICANA.

Muhlenbergia Mexicana Trin. Unifl. 189. 1824. Watson and Coulter Gray. Man. Bot. 643. 1890. (6th ed.) Scribner. Grasses of Tenn. Publ. Univ. Tenn. Agrl. Exp. Sta. 7: 68. f. 83. 1894. Vasey Contr. U. S. Nat. Herb. 3: 69.

Muhlenbergia Mexicana (L.) Trin. Beal. Grasses of N. A. 2: 252.
 . Nash in Britton and Brown. Ill. Fl. 1: 142. f. 321. 1896. Scribner.
 . U. S. Dept. Agri. Div. Agros. 7: 106. f. 100. 1900. (3d ed.)

Agrostis Mexicana L. Mant. 1: 31. 1767.

Agrostis filiformis Muhl. Gram. 66. 1817.

Agrostis lateriflora Michx. Fl N. Am. 1: 53. 1803.

DESCRIPTION.

MEXICAN DROP SEED. An upright or ascending, usually much branched perennial 1 to 3 feet (2-6 dm.) high, with a scaly, creeping rootstock, numerous flat leaves and contracted, densely-flowered



panicles. Sheaths longer or shorter than the internodes, smooth; ligule $\frac{1}{2}$ line (1 mm.) or less long; leaf-blades 1 to 3 lines (2-6 mm.) wide, 2 to 7 inches (4-14 cm.) long. Spikelets about 1 line (2 mm.) long on very short pedicels; empty glumes nearly equal, acuminate-pointed, about the length of the floral glume (a little shorter or sometimes a little longer), scabrous on the keel; flowering glume lanceolate, acute or mucronate-pointed, three-nerved, pilose near the base and on the callus. Palea a little shorter than its glume, very acute.

Mexican drop seed is a widely distributed grass, abundant in all parts of the state. It is somewhat polymorphic. Ordinarily the spikes approach in density the *M. glomerata*, but when cut off before heading out the spikes are more slender, and might readily be mistaken for another species. This is the state called var. *filiforme*.

FIG. 96. *Muhlenbergia Mexicana*—a, b, spikelets. (Div. Agros. U. S. Dept. of Agri.)

The grass matures rapidly and affords early forage, but later becomes woody. In cultivated gardens and fields it is a bad weed.

DISTRIBUTION.

Iowa. Woodbine, 11 and 7 (Burgess); Ft. Dodge (Pammel and Sokol, Oleson); Boone, 3202 (Pammel); Steamboat Rock, 3146 (Miss King); Keokuk (P. H. Rolfs); Grundy Center, 3208 (Miss Paddock); Wilsonville, 3183 (Larsen); Lansing, 3010 (Miss King); Sioux City (Miss Wakefield); Ames (Pammel, Kaufman, Ketterer, Crozier, Sirrine, Fairfield); Belknap, 827 (Rankin); Rock Rapids (Shimek); Jewell Junction, De Witt, Carroll, Turin, Logan, Jefferson, Sheldahl and Slater, 251 Clinton (Pammel); Myron (Miss King); Spirit Lake, 16 (Beard); Dixon, 734 (Snyder); Mt. Pleasant (Mills); Red Oak (Holt); Hesper (Ballard); 1013, Creston (Bettenga); Glenwood, 998 (Jackson); Chariton, 779 (Mallory); Parkersburg, 941 (Stout); Ames, 115 (Ball); Amana, 697 (Schadt); Carroll, 1018 (Simon); Boone (Carver); Greenfield (Stewart); Ames, 114 (Pammel); Jackson County, Rapid Creek, Johnson County, Hamilton to Hancock County (Preston); Sioux City (Macbride); Iowa City (Hitchcock); Steamboat Rock (Miss King); Steamboat Rock (Shimek); Nevada (Pammel); Traer (Provan).

North America. New Brunswick, Washington, D. C. (Potomac Flats, Ball, 712); to North Carolina, Texas, Missouri (St. Louis, Eggert; Jefferson Barracks, Eggert), Indian Territory, Nebraska, Minnesota, Wisconsin (La Crosse, D. S. Pammel and C. M. King; Bloomingdale, Pammel and C. M. King, 3175), Ohio (Pickerington, Horr); to Ontario. *

3. MUHLENBERGIA GLOMERATA.

Muhlenbergia glomerata Trin. Unif. 191. 1824. Watson and Coulter. Gray. Man. Bot. 543. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 67. f. 81. 1894. Vasey Contr. U. S. Nat. Herb. 3: 68.

Muhlenbergia racemosa (Michx.) B. S. P. Beal. Grasses of N. A. 2: 252. 1896. Nash in Britton and Brown. Ill. Fl. 1: 143. f. 322. 1896. Scribner. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 7: 109. f. 103. 1900. (3d ed.)

Polygona glomeratus Willd. Enum. 1: 87. 1809.

Agrostis racemosa Michx. Fl. Bor. Am. 1: 53. 1803.

Muhlenbergia racemosa B. S. P. Prel. Cat. N. Y. 67. 1888.

DESCRIPTION.

MARSH MUHLENBERGIA.

A rather stout, upright perennial, with very tough and densely scaly root-stocks, nearly simple culms, 2 to 3 feet (6-9 dm.) high, and densely flowered panicles, 2 to 4 inches (5-10 cm.) long. Spikelets 2 to 3 lines (4-6 mm.) long, the long, acuminate-pointed outer glumes nearly equal and exceeding the very acute flowering glume, which is densely bearded at the base. Moist meadows and low grounds. July-September.

Marsh Muhlenbergia is common, especially in northern Iowa, but occurs in all parts of the state. A rapid grower and when young affords some forage.



FIG. 97. *Muhlenbergia glomerata*—a, spikelet with long, acuminate-pointed outer glumes; b, flowering glume, bearded. (Div. of Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. Boone, 3228 (Pammel); Rockwell, 3186 (Brown); Mason City (Pammel); Greenfield (Stewart); Winterset, Des Moines (Carver); Jewell Junction (Rolfs); Logan, Council Bluffs, Sioux City,

Clinton, South Dakota opposite Hawarden, 274 Webster City, Carnarvon, Alton, Sioux Rapids, Dakota City, Hawarden (Pammel); Sioux City (Miss Wakefield); Ames (Kaufman, Hitchcock); West Union, 248 (Whitmore); Ames, 113 (Ball); Lyon County, 45 (Shimek); Keystone (Koch); Dallas Center, 817 (Rhinehart); Tabor (Baldwin); Muscatine (Reppert); Ledyard, 760 (Pammel and Cratty); Tabor, 778 (Baldwin); Webster City, 2217 (Pammel and Sokol); Armstrong (Cratty); Council Bluffs (Miss Cavanagh and Dilne); Rock Rapids (Shimek); Iowa City (Hitchcock and Macbride); Hamilton to Hancock County (Preston); Spirit Lake, Lyon County (Shimek); Plymouth County (Brown); High Bridge (Lummis); Woodbury County (Brown); Worth County (Pammel).

North America. From New Jersey to Missouri (St. Louis, Egbert, Pammel); Ohio (Columbus, Sullivant); Wisconsin (La Crosse, Pammel, C. M. King); Minnesota (Sandy Lake, Sandberg); Iowa, Nebraska (Crete, Pammel; Lincoln, Pammel); Dakota (Vasey); mountains of Colorado (northern Colorado, Soldier's Canon, Crandall; Ft. Collins, Pammel); New Mexico (Parry); Utah (West Duchesne River, 8500 ft., Pammel and Stanton; East Duchesne River, Pammel and Stanton), and Arizona; north to British Columbia; eastward to Newfoundland.

4. MUHLENBERGIA DIFFUSA.

Muhlenbergia diffusa Schreb. Besch. Gras. 2: 143. pl. 51. 1772. 79. Watson and Coulter. Gray. Man. Bot. 644. 1890. (6th ed.) Scribner, Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 67. f. 80. 1894. Nash in Britton and Brown. Ill. Fl. 1: 144. f. 327. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 105. f. 99. 1900. (3d ed.) Vasey Contr. U. S. Nat. Herb. 3: 68.

Muhlenbergia Schreberi Gmel. Beal. Grasses of N. A. 2: 245. 1896.

DESCRIPTION.

NIMBLE WILL. A low, ascending perennial with slender, much-branched, wiry culms, 1 to 2 feet (2-4 dm.) long. Sheaths smooth, pilose at the throat; ligule very short; leaf blade 1 to 2 lines (2-4 mm.) wide, 1 to 4 inches (2-8 cm.) long, scabrous on both sides. Panicles 3 to 7 inches (6-14 cm.) long, slender, branches erect, rather densely flowered. Spikelets 1 line (2 mm.) long, equalling or exceeding the pedicels; empty glumes minute, unequal, the lower sometimes obsolete; flowering glume narrowly lanceolate, pilose near the base, scabrous on the nerves above, terminating in a slender, straight awn, 1 to 2 lines (2-4 mm.) long; palea equalling the glume. Shaded thickets, border of woods, waste ground about dwellings. July to September.

Nimble Will was originally confined to southeastern Iowa. It has spread northward along the Mississippi, where it is now abundant as far north as Dubuque. It is also spreading in central Iowa. The grass is of little economic importance.

DISTRIBUTION.

Iowa. Ames (Pammel, Bessey, Hitchcock); Dixon, 735 (Snyder); Fayette (Fink); Clinton, 247 (Pammel); Manchester, 942 (Ball); Libertyville, 935 (Baldwin); Mt. Pleasant, 993 (Witte); Muscatine, 516 (Reppert); Des Moines, 635 (Pammel); Mt. Pleasant (Mills); Jefferson (Pammel); Mt. Ayr, 642 (Beard); Red Oak (Holt); Hamilton to Hancock County (Preston); Iowa City (Macbride); Des Moines (Pammel).

North America. Maine to New York and Florida; west to Alabama, Texas (Kerrville, J. G. Smith), Kentucky (Bell County, Kearney), Missouri, Kansas, Nebraska, Iowa, Illinois, Wisconsin, Minnesota and Ontario.



FIG. 98. *Muhlenbergia diffusa*—a, empty glumes; b, spikelets; c, flowering glume. (Div. Agros. U. S. Dept. of Agri.)

5. MUHLENBERGIA WILLDENOVII.

Muhlenbergia Willdenovii Trin. Unif. 188. 1824. Watson and Coulter. Gray. Man. Bot. 643. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 68. f. 35. 1894.

Muhlenbergia tenuiflora (Willd.) B. S. P. Beal. Grasses of N. A. 2: 255. 1896. Nash in Britton and Brown. Ill. Fl. 1: 144. f. 326. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 107. f. 101. 1900. (3d ed.)

Agrostis tenuiflora Willd. Spec. 1: 364. 1799.

Agrostis pauciflora Pursh. Fl. Am. Sept. 1: 63. 1814.



FIG. 99. *Muhlenbergia Willdenovii*—a, spikelets with unequal outer glumes; b, flowering glumes and bearded callus. (Div. Agros. U. S. Dept. Agrl.)

DESCRIPTION.

SLENDER MUHLENBERGIA.

An erect, simple or sparingly-branched perennial, 1 to 3 feet (3-9 dm.) high, with creeping, scaly rootstocks, flat leaf blades and rather few-flowered, linear panicles, 6 to 12 inches (15-30 cm.) long, the branches appressed. Spikelets $1\frac{1}{2}$ lines (3 mm.) long; empty glumes slightly unequal, acute, about one-half the length of the flowering glume; callus bearded; awn slender, about 4 lines (8 mm.) long. Rocky woods, July to August.

Widely distributed in eastern and central Iowa, but never abundant.

DISTRIBUTION.

Iowa. Ames (Hitchcock, Bessey, Carver); Muscatine (Barnes); Dallas Center, 920 (Rhinehart) Winterset, 260 (Carver); Muscatine (Reppert); Iowa City (Hitchcock, Macbride).

North America. Massachusetts to Ontario, Ohio (Columbus, Sullivant), Minnesota, Iowa, Missouri (Eggert), Texas, Alabama and Virginia.

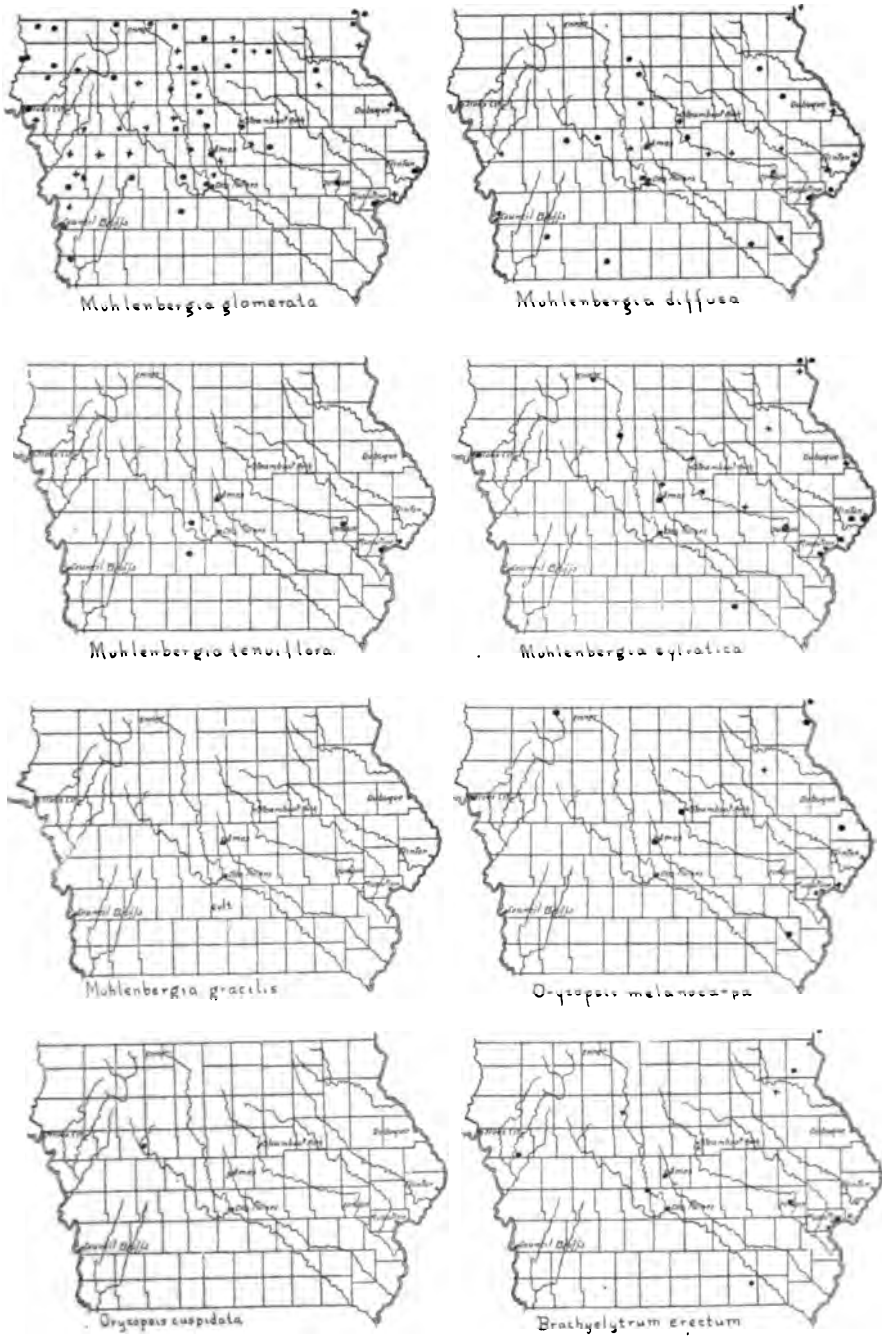


Fig. 100. Map showing distribution of *Muhlenbergia*, *Oryzopsis* and *Brachyelytrum*.
 • Herbarium. + From observation.

6. MUHLENBERGIA SYLVATICA.

Muhlenbergia sylvatica Torr. Fl. U. S. 1: 87. 1824. Scribner. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 7: 108. f. 102. 1900. Nash in Britton and Brown. Ill. Fl. 1: 143. f. 323. 1816. Scribner. Gen. of Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 20: 65. f. 43. 1900.

Muhlenbergia sylvatica Torr and Gray. Watson and Coulter in Gray. Man. Bot. 643. pl. 8. f. 1 and 2. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 68. f. 84. 1890.

Agrostis diffusa Muhl. Gram. 64. 1817.

DESCRIPTION.

WOODLAND DROP SEED.

A perennial, much branched grass, 6-9 dm. high, with strong, scaly rootstocks, flat leaves and narrow, densely flowered panicles, 5-15 cm. long. Leaf blades rough, 5-18 cm. long, 2-6 mm. wide. Spikelets about 2 mm. long; empty glumes nearly equal, very acute, one-half as long or nearly equalling the flowering glume; flowering glume pilose below, scabrous above, and terminating in a slender awn 4-12 mm. long.

DISTRIBUTION.

Iowa. Sioux City (Miss Wakefield); 1455 De Witt, 111 Dakota City, 250 Clinton (Pammel); Iowa City (Macbride); Blue Grass (Barnes); Ames (Crozier); Iowa City (Hitchcock); Emmet County, 930 (Pammel and Cratty); Belknap, 923 (Rankin).



FIG. 101. *Muhlenbergia sylvatica*—a, b, spikelets; c, with outer or lower glumes removed, showing callus. (Div. of Agros. U. S. Dept. Agrl.)

North America. New Brunswick to Ontario and Minnesota; south to North Carolina, Texas and Indian Territory; Arkansas (Harvey); Missouri (Eggert); Connecticut (Hartford County, F. Wilson), Kentucky (Harlan, Kearney); west to Colorado (Ft. Collins).

7. MUHLENBERGIA GRACILIS.

Muhlenbergia gracilis Trin. Unifl. 193. 1824. Scribner. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 7: 117. f. III. 1900.

Muhlenbergia gracilis (H. B. K.) Trin. Beal Grasses of N. A. 2: 242. 1896.

DESCRIPTION.

SLENDER DROPSEED GRASS.

A slender but rather rigid, densely caespitose perennial, 1.5-6 dm. high, with narrow, involute, rigid leaves, and contracted panicles 8-15 cm. long; spikelets 3-4 mm. long; empty glumes nearly equal in length, the first about one-half as long as the flowering glume, 1-nerved, acute, or erose at apex, the second a little longer than the first, 3-nerved and 3-toothed, rarely entire at the apex; flowering glume pubescent or scabrous on the back, ciliate on the margins; awn flexuous 8-16 mm. long. Dry soils June to September.

DISTRIBUTION.

Iowa. Occasionally cultivated. Ames, cult. (Pammel).

North America. Texas to Arizona and Mexico, Colorado (Colorado Springs, Tracy); Colorado (Vasey; E. D. Ball, 8500 ft.; Ft. Collins, Pammel, 334; Bosworth's Ranch, Larimer County, Crandall; Parry), and Wyoming.



FIG. 102. *Muhlenbergia gracilis*—a, b, empty glumes nearly equal; c, d, pubescent flowering glume. (Div. of Agros. U. S. Dept. of Agrl.)

4. ORYZOPSIS.

Oryzopsis Michx. Fl. Bor. Am. 1: 51. pl. 9. 1803. Endlicher Gen. Pl. 87. Bentham and Hooker. Gen. Pl. 3: 1142. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 46. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 63. f. 41.

Urachne Trin. Fundam. Agros. 109. 1820.

Eriocoma Nutt. Gen. N. Am. Pl. 1: 40.

Fendleria Steud. Syn. Pl. Shun 1: 419. (Fendler Collection 979.)

Caryochloa Spreng. Syst. Cur. Post. 22: 30. 1827.

Piptatherum Beauv. Agros. 17. 1812.

Piptochaetium Presl. Rel. Haenk. 1: 222. 1830.

Nassella D. Desv. in Gay. F. Chili. 6: 263. 1845.

Spikelets 1-flowered, nearly terete. Lower glumes herbaceous or thin membranaceous, several-nerved, nearly equal, commonly rather longer than the oblong flower, which is deciduous at maturity, and with a very short, obtuse callus or scar-like base. Flowering glume coriaceous, at length involute so as closely to enclose the equal pale and the oblong grain; a simple untwisted and deciduous awn jointed on its apex. Stamens 3. Squamulae 2 or 3, conspicuous. Stigmas plumose. Perennials, with rigid leaves and a narrow raceme or panicle. Spikelets greenish, rather large. (Name composed of two Greek words for *rice* and *likeness*, from a fancied resemblance to that grain.)

Bentham & Hooker give the number of species as 24; Hackel 15. Found chiefly in the warmer temperate zones of both hemispheres; Heller gives the number as 11, which includes *Eriocoma*.

KEY TO THE SPECIES OF ORYZOPSIS.

Flowering glume sparingly pubescent, awn about 20 mm. long.

—*O. melanocarpa*.¹

Flowering glume densely silky-hirsute, awn about 5 mm. long.

—*O. cuspidata*.²

1. ORYZOPSIS MELANOCARPA.

Oryzopsis melanocarpa Muhl. Gram. 79. 1817. Watson and Coulter. Gray. Man. Bot. 642. 1890. (6th ed.) Beal. Grasses of N. A. 2: 225. 1896. Nash in Britton and Brown. Ill. Fl. 1: 140 f. 317. 1896. Scribner. Am. Grasses. Bull. U. S. Dept. Agr. Div. Agros. 7: 98. f. 92. 1900. (3d ed.) Vasey Contr. U. S. Nat. Herb. 3: 56.

DESCRIPTION.

BLACK-FRUITED MOUNTAIN RICE. A rather stout, long and broad-leaved perennial, 1 to 3 feet (3-9 dm.) high, with narrow, simple panicles, 6 to 8 inches (15-20 cm.) long, branches spreading in flower, the lower ones in pairs, and about 2 inches (5 cm.) long, flower-bearing above, naked below. Spikelets few, 4 to 5 lines (8-10 mm.) long; empty glumes about 7-nerved, acute, slightly exceeding the thinly pubescent and coriaceous flowering glume; awn about 12 lines (24 mm.) long. Open, rocky woods, sometimes on cliffs. Quebec and Ontario to Delaware, Kentucky, Missouri and Minnesota.

Black-fruited mountain rice occurs sparingly in the woods of eastern, central and northwestern Iowa.



FIG. 108. *Oryzopsis melanocarpa*—a, b, spikelet, coriaceous flowering glume and awn. (Div. of Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. Ames, Okoboji Lake (Hitchcock); Mt. Pleasant (Mills); Ames, 1005 (Ball); Sioux City (Miss Wakefield); Jackson County (Shimek); Steamboat Rock 3147, 3192 Lansing (Miss King).

North America. Ontario, Vermont, New Jersey, south to Kentucky, Pennsylvania (Lycoming County, Small), Ohio (Springfield, Sullivant), to Missouri, Iowa, Minnesota and Wisconsin.

2. ORYZOPSIS CUSPIDATA.

Oryzopsis cuspidata Benth. Vasey. U. S. Dept. Agr. Sp. Report 63: 23. 1883. Nash in Britton and Brown. Ill. Fl. 1: 141. f. 378. Scribner Bull. U. S. Dept. Agr. Div. Agros. 7: 103. f. 97. (3d ed.)

Stipa membranacea Pursh. Fl. Am. Sept. 2: 728. 1814.

Eriocoma cuspidata Nutt. Gen. 1: 40. 1818

Oryzopsis membranacea Vasey. Bull. U. S. Dept. Agr. Div. Bot. 12: 10. pl. 10. 1891. Contr. U. S. Nat. Herb. 3: 56.

Fendleria rhychelytoides. Steud. Syn. Pl. Glum. 1: 19. 1855.



DESCRIPTION.

INDIAN MILLET. A tough perennial, growing in bunches, 1 to 2½ feet (3-7 dm.) high, with narrow, involute leaves, and dichotomously branched, diffuse panicles, 5 to 6½ inches (12-15 cm.) long. Spikelets, 3 to 4 lines (6-8 mm.) long, on filiform and flexuous pedicels; empty glumes pubescent, 3 to 5-nerved, broad and ventricose below, attenuate-pointed, much longer than the densely long-hairy, and broadly oval flowering glume; awn about 2 lines (4 mm.) long, readily falling off. The hairs finally fall from the flowering glume, which becomes very hard, smooth and shiny.

FIG. 104. *Oryzopsis cuspidata*—a, spikelet; b, flowering glume. (Div. of Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. A single specimen is reported from Iowa, collected by Prof. A. A. Crozier in the vicinity of Wall Lake. Whether this was a slip in writing the label I do not know. No other collector has ever recorded it for this state. The specimen bearing this label was destroyed in the fire.

North America. South Dakota to New Mexico (Parry), Texas to California (Vasey), Nevada (Pammel), Utah (East Duchesne, Pammel and Stanton; West Duchesne, Pammel and Stanton), Colorado (Ft. Morgan, Pammel; Denver, Ft. Collins, E. D. Ball; New Windsor, Osterhout, 2378; Ft. Collins, Crandall; Larimer County, Crandall and Cowen; Marshall Pass, Tracy, 454); Wyoming (Sherman, Pammel; Egbert, Pammel and Brownlie; Green River, Parry; New Castle, Pammel; Yellowstone Park, Mammoth Hot Springs, A. and E. Nelson).

5. MILIUM.

Milium. L. Sp. Pl. 61. 1753. Endlicher. Gen. Pl. 82. Bentham and Hooker. Gen. Pl. 3: 1143. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II, 2: 47.

Miliarium Moench. Meth. 204. 1794.

Spikelets 1-flowered; rachilla articulated above the empty glumes, not produced into a conspicuous callus, nor extended above the flowering glume. Glume 3, obtuse, awnless, the first two empty, subequal, membranous, convex; the third or flowering glume usually smooth and shining, becoming indurated in fruit; palea nearly as long as its glume. Stamens 3. Styles short, distinct; stigmas plumose. Grain ovoid or oblong, free within the hardened glume and palea. Annual or perennial grasses, with flat leaves and open panicles, differing from *Oryzopsis* in the obtuse and awnless flowering glume.

Bentham and Hooker give the number of species as 5 or 6; Engler and Prantl, the same number. Found chiefly in the temperate regions of Europe, Asia and North America. America one species; Eurasia 5 to 6.

MILIUM EFFUSUM.

Milium effusum. L. Sp. Pl. 61. 1753.



FIG. 105. *Milium effusum*—a, b, spikelets; c, dorsal view of flowering glume; d, anterior view of the same showing a portion of the nearly enclosed palea. (Div. of Agros. U. S. Dept. Agri.)

DESCRIPTION.

WILD MILLET. A pale green perennial, with simple culms, 2 to 4½ feet (6-14 dm.) high, with broad, flat, spreading leaves, and diffuse panicles 6 to 8 inches (15-20 cm.) long. Branches of the panicle two to five together, flower-bearing above, naked below. Spikelets 1½ lines (3 mm.) long, empty glumes nearly equal, 3-nerved, a little longer than the oblong, obtuse flowering glume.

DISTRIBUTION.

This species is included as there is a possibility of its occurrence in the northeastern part of the state.

North America. From New England states to Pennsylvania and Michigan; Ohio (Worthington, Horr; Painsville, Beardslee); west to Minnesota, and from Cape Breton Island to Quebec and western Ontario.

6. BRACHYELYTRUM.

Brachyelytrum Beauv. Agros. 39. *pl.* 9. *f.* 2. 1812. Bentham and Hooker. Gen Pl. 3: 1144. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 17. Scribner. Bull. U. S. Dept. Agri. Div. Agros. 20: 66. *f.* 44.

Muhlenbergia in part. Endlicher. Gen. Pl. 88.

Spikelets 1-flowered, with a conspicuous, filiform pedicel of an abortive, second flower about half its length, nearly terete, few, in a simple, appressed panicle. Lower glumes unequal, persistent, usually minute, or the lower one almost obsolete. Flowering glume and palea chartaceous-herbaceous, involute, enclosing the linear-oblong grain, somewhat equal, rough with scattered, short bristles, the first 5-nerved, extended into a long, straight awn, the palea 2-pointed; the awn-like sterile pedicel partly lodged in the groove on its back. Stamens 2; anthers and stigmas very long. Perennial, with simple culms, 1 to 3 feet (2-6 dm.) high, from creeping rootstocks; downy sheaths, broad and flat lanceolate-

pointed leaves, and spikelets $\frac{1}{2}$ inch (1 cm.) long without the awn. (Name composed of two Greek words for *short* and *husk*, from the minute glumes.)

Brachyelytrum is monotypic; one living species found in eastern North America.

BRACHYELYTRUM ERECTUM.

Brachyelytrum erectum Beauv. Agros. 39. 1812. (Schreb.) Beauv. Beal. Grasses of N. A. 2: 269. f. 46. 1896. Nash in Britton and Brown. Ill. Fl. 1: 146. f. 332. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 118. f. 112. 1900.

Brachyelytrum aristatum R. & S. Syst. 2: 413. 1817. Beauv. Watson and Coulter. Gray. Man. Bot. 644. pl. 8. 1890. (6th ed.) Vasey Contr. U. S. Nat. Herb. 3: 71. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 69. f. 86. 1894.

Brachyelytrum aristatum var. *Engelmanni*. A. Gray. Man. Bot. 614. 1867. (5th ed.) Watson and Coulter. Gray. Man. Bot. 644. 1890. (6th ed.) Vasey. Contr. U. S. Nat. Herb. 3: 71.

Dilepyrum aristosum Michx. Fl. Bor. Am. 1: 40. 1803.

Muhlenbergia erecta Schreb. Besch. Gras. 2: 139. pl. 50 1772-9.

Muhlenbergia aristata Pers. Syn. 1: 76. 1805.

DESCRIPTION.

BRACHYELYTRUM. A perennial, with simple culms 1 to 3 feet (3-9 dm.) high; flat, spreading leaf-blades and few-flowered, simple, terminal panicles 2 to 6 inches (5-15 cm.) long. Nodes and sheaths pubescent. Leaf-blades 3 to 6 inches (7-15 cm.) long, 6 to 7 lines (12-14 mm.) wide. Spikelets 5 to 6 lines (10-12 mm.) long; empty glumes very unequal, the first minute; flowering glume 4 to 6 lines (8-12 mm.) long, ciliate, scabrous along the prominent nerves; awn straight, 9 to 12 lines (18-25 mm.) long. Palea about as long as its glume. Rachilla continued behind the palea as a slender, naked bristle, one-half to two-thirds as long as the palea. Open, rocky woods. May to August.



FIG. 100. *Brachyelytrum erectum*—a, spikelet; b, the same with the awn and short empty glumes removed; c, empty glumes; d, palea (Div. of Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. Wild Cat Den, 11 (Ball); Smithland (Wakefield); Ames, 158 and 195 (Ball, Hitchcock); Iowa City (Hitchcock); Myron (Miss King); High Bridge, Dallas County (Shimek); Unionville (Shimek).

North America. From the New England states to North Carolina; District of Columbia (Conant), New York (Washington County, Parry); Alabama to Missouri, northwestern Iowa, Nebraska, Minnesota; Canada east to Newfoundland.

7. PHLEUM.

Phleum L. Sp. Pl. 59. 1753 Endlicher. Gen. Pl. 81. Bentham and Hooker. Gen. Pl. 3: 1146 Hackel in Engler and Prantl. Nat. Pflanz Fam. II. 2: 48. f. 47.

Stelephuros Adans. Fam. 2: 31.

Chilochloa Beauv. Agros. 37. pl. 7. f. 2. Nees. Gen. Fl. Germ. Monocot. 1: n. 6. Reichb. Ic. Fl. Germ. Pl. 51.

Achnodotum Beauv. Agros. 24. pl. 7. f. 5.

Spikelets 1-flowered, in a very dense, cylindrical, spike-like panicle. Lower glumes persistent, membranaceous, folded-carinate, subtruncate, mucronate or short-awned; flowering glume hyaline, shorter, truncate. Stamens 3. Styles distinct. Perennials. (From the Greek name for : kind of reed.)

According to Bentham and Hooker and Hackel there are 10 species found in Europe. The genus is found chiefly in central and western Asia and northern Africa and temperate and boreal regions of North America. Bell credits North America with but a single native species, *Phleum alpinum*; Heller also recognizes only one. There are, however, two good native species.

PHLEUM PRATENSE.

Phleum pratense L. Sp. pl 59. 1753. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 120. f. 114. 1900. (3d ed.) Vasey. Contr. U. S. Nat. Herb. 3: 86. Watson and Coulter. Gray. Man. Bot. 645. pl. 7. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 70. f. 87. 1894. Beal. Grasses of N. A. 2: 276. 1896. Nash in Britton and Brown. Ill. Fl. 1: 147. f. 334. 1896.

DESCRIPTION.

TIMOTHY. HERD'S GRASS.

Culms simple, 1 to 3 feet (2-7 dm.) high, panicle 1 to 4 inches (2-8 cm.) long, very densely many-flowered. Empty glumes about 1 line (2 mm.) long, the strong, ciliate keels projecting into sharp, mucronate points, which are shorter than the glume. Floret entirely concealed within the outer glumes, the stamens and feathery stigmas protruding from the apex. Widely cultivated and completely naturalized in fields, wayside and waste grounds; throughout the United States and British America. June to August.

Timothy occurs in all parts of Iowa. It was early introduced by Iowa farmers because of its excellent qualities as a forage plant.



FIG. 107. *Phleum pratense*--a, empty glumes; b, the floret showing three stamens and two stigmas. Div. of Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. Muscatine, 40 (Ball); Lawler (P. H. Rolfs); Armstrong 3720, Gridley 3241, Mason City 3240 and 3213, Ceylon 3309, Hawarden, Jefferson, Mason City, Carroll, Elmore, Minn., Minnesota-Iowa line 661, New Albin 849, Ledyard, Logan, Council Bluffs 1281, Sioux City, Council Bluffs 1304 (Pammel); 3046 and 3061 Pilot Mound, 3145 Steamboat Rock (Miss King); Clinton, 269 (Ball); Marshalltown (Eckles); Wheatland (Ball); Ontario, 3280 (Faurot); Armstrong, 746 (Pammel and

Cratty); Dixon, 737 (Snyder); Taylor County, 1111 (Pool); Harcourt (Danielson); Hamilton County (P. H. Rolfs); Muscatine, 404 (Reppert); Cedar Rapids (Miss Hall); Belknap, 833 (Rankin); Benton County, Dysart (Miss Sirrine); Sioux City (Miss Wakefield); Ames (E. R. Wilson, Rich and Gossard, Hitchcock, Miss Wood, P. H. Rolfs, Meredith, Pammel, Fairfield, 122 Ball, 1161 Pammel); Keystone (Koch); Battle Creek, 960 (Preston); Jewell Junction, Indianola (Carver); Le Claire (F. Rolfs); Keokuk (P. H. Rolfs); Alden, 1119 (Stevens); Durant, 1134 (Weaver); Iowa City (Hitchcock); High Bridge, Dallas County (Shimek); Decatur County (Shimek).

North America. Commonly naturalized from New England to Florida; west to Tennessee and Alabama, western Arkansas (P. H. Rolfs), northwestern Missouri, Kansas, Nebraska (McCook, 378; Broken Bow, 8; Aurora, 5; Hastings, 13; Pammel), and the Rocky Mountains of New Mexico; Utah (Uintah Mountains, White Rock Agency, Pammel and Stanton, 137; East Lake Fork, 141; West Duchesne, Pammel and Stanton, 138; East Duchesne, Pammel and Stanton, 139); Colorado (Ft. Collins, Pammel, alt. 6500 ft.; Greeley, Stove Prairie Hill, Larimer County, Beaver Creek, Pammel); Wyoming (New Castle, 9; Big Horn Mountains, 7, 11, Pammel; Elk Mountain, Stanton and Little); Minnesota (Itaska Lake, Sandberg; Parry); Wisconsin (Madison, La Crosse, Pammel); Illinois (Madison County, Eggert).

General. Great Britain, common on the continent of Europe, North Africa, Siberia and western Asia, naturalized in Australia.

8. ALOPECURUS.

Alopecurus L. Sp. Pl. 60. 1753. Endlicher. Gen. Pl. 80. Engler and Prantl. Nat. Pflanz. Fam. 11. 2: 48. f. 48. Bentham and Hooker. Gen. Pl. 3: 1140. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 70. f. 48. (Rev. ed.)

Colobachne Beauv. Agros. 22. pl. 6. f. 9. Nees. Gen. Fl. Germ. Monocot. 1: n. 8. Reicheb. Ic. Fl. Germ. pl. 50. f. 1480. 1812.

Tozzettia Savi. Mem. Soc. Ital. Sc. 8: 477. 1868.

Spikelets 1-flowered, jointed on the pedicel. Lower glumes boat-shaped, strongly compressed and keeled, nearly equal, united at the base, equalling or exceeding the flowering glume, which is awned on the back below the middle; palea mostly wanting. Stamens 3; styles mostly united. Stigmas long and feathered. Clusters contracted into a cylindrical and soft, dense spike; perennial. (Name from Greek words for *fox* and *tail*, from the shape of the spike.)

Bentham & Hooker recognizes 20 species, although 40 have been described; Hackel recognizes 20 species. Found chiefly in Europe, and extreme tropical Asia and North America; a few in South America and Australia, but doubtfully indigenous. Heller lists 11 species; Beal 11 species.

KEY TO THE SPECIES OF ALOPECURUS.

Empty glumes 2 to 2.5 mm. long.....*A. geniculatus*.¹
 Empty glumes 4 to 6 mm. long.....*A. pratensis*.²

1. ALOPECURUS GENICULATUS.

Alopecurus geniculatus L. Sp. Pl. 60. 1753, Watson and Coulter. Gray Man. Bot. 645. *pl.* 7. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 71. *f.* 89. 1894. Scribner. American Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 7: 121. *f.* 115. 1900. (3d ed.) Vasey. Contr. U. S. Nat. Herb. 3: 87. Beal. Grasses of N. A. 2: 280. 1896. Nash in Britton and Brown. Ill. Fl. 1: 149. *f.* 337. 1896.

Alopecurus geniculatus var. *fulvus*. Smith. Scrib. Mem. Torr. Bot. Club. 5: 38. 1894.

Alopecurus geniculatus var. *aristulatus* Torr. Fl. U. S. 1: 97. 1824. Vasey. Contr. U. S. Nat. Herb. 3: 87.

Alopecurus aristulatus Michx. Fl. Bor. Am. 1. 43. 1803.

DESCRIPTION.



FIG. 103. *Alopecurus geniculatus*—a. b, spikelets; c, flowering glume. (Div. of Agros. U. S. Dept. Agrl.)

MARSH FOX TAIL. A slender perennial, more or less decumbent, and branched at the base, the lower joints geniculate, the stems finally ascending or erect, 6 to 24 inches (1-5 dm.) high, with rather short, spreading, flat leaves and spike-like, densely flowered panicles, 1 to 3 inches (2-6 cm.) long. Sheaths smooth, the upper usually somewhat inflated; ligule 1 to 2 lines (2-4 mm.) long; leaf-blades smooth or a little scabrous, the lower 3 to 6 inches (6-12 cm.) long, the upper shorter, 1 to 3 lines (2-6 mm.) wide. Spikelets strongly compressed laterally, oblong, about one line long; empty glumes rather obtuse, equal, nearly distinct or only slightly connate near the base, silky, hairy on the keels and sparingly pilose on the sides; flowering glume a little shorter than the outer ones, awned from near the base; awn very slender, nearly twice as long as the glumes. Wet meadows, banks of streams and ditches throughout the United States, and from Newfoundland to British Columbia. May to September. Common along all of the larger streams, abundant along the Mississippi and Missouri rivers.

DISTRIBUTION.

Iowa. Sedan, 3379 (Pammel); Ames (Rich and Gossard); Des Moines (Carver); Lyon County, Johnson County (Shimek); Osgood (Roberts); Maquoketa (Goodenow); Armstrong, Emmet County, Lyon County (Cratty); Lake Okoboji (Hitchcock); Iowa City (Macbride, Shimek, Bartsch); Johnson County (Miss Linder); Decatur County, (Shimek).

North America. Newfoundland to Nova Scotia, Ontario, Manitoba, Vancouver north to lat. 55°; from Maine south to New York

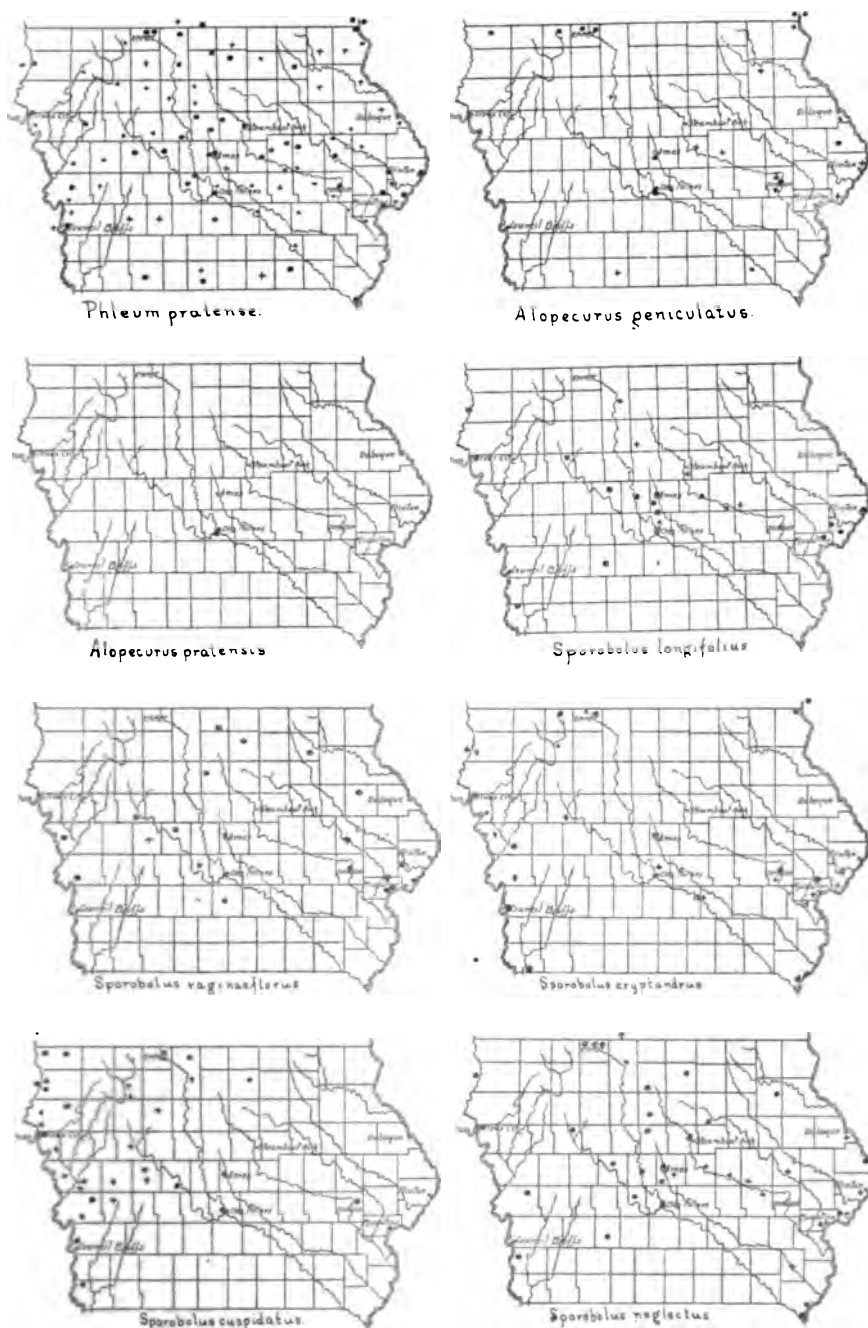


FIG. 103. Distribution of *Phleum*, *Alopecurus*, and *Sporobolus*.
 ● Specimens in herbarium. † Localities observed.

(Washington County (Parry), Connecticut (Hartford County, F. Wilson), Pennsylvania, Ohio (Baltimore, Horr; Columbus, Sullivant); west Missouri; northwest through Iowa, Nebraska, Minnesota (St. Peter River, Parry), to the Rocky Mountains in Colorado (Larimer County, Crandall), Utah (Echo, Pammel, Johnson, Buchanan and Lummis, alt. 6500 ft.; East Duchesne, Pammel and Stanton; East Lake Fork), Wyoming (Albany County, E. Nelson, 3379), Idaho (Kootenai County, Sandberg, Heller and McDougall), California (Bolander).

General. Great Britain, Europe general, North Africa, Siberia, Dahuria, western Asia to India, Australia and New Zealand.

2. ALOPECURUS PRATENSIS.

Alopecurus pratensis L. Sp. Pl. 60. 1753. Watson and Coulter. Gray. Man. Bot. 645. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 70. f. 88. 1894. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 7: 122. f. 116. 1900. (3d ed.) Beal. Grasses of N. A. 2: 278. 1896. Nash in Britton and Brown. Ill. Fl. 1: 149. f. 338. 1896. Vasey. Contr. U. S. Nat. Herb. 3: 86.

DESCRIPTION.

MEADOW FOX TAIL. An erect perennial, 1 to 3 feet (2-7 dm.) high, from a short, creeping root-stock. Sheaths smooth, the uppermost usually somewhat inflated and longer than the leaf-blade; ligule hyaline, obtuse, about a line long; leaf-blade linear or narrow-lanceolate, acute, the lower 4 to 10 inches (8-20 cm.) long, 2 to 3 lines (4-6 mm.) wide. Panicle rather stout, obtuse, 2 to 4 inches (4-8 cm.) long. Spikelets flat, 2 to 3 lines (4-6 mm.) long; empty glumes distinct or slightly grown together near the base, abruptly acute, silky villous on the keels and shortly pilose on the lateral nerves; flowering glume nearly as long as the empty ones, awned on the back near or below the middle; awn slender, slightly twisted, and projecting beyond the glumes for more than half its length. Naturalized in fields and meadows. June-July.



FIG. 110. *Alopecurus pratensis*—a, a spikelet showing the connate, hairy glumes, 3 stamens and 2 styles; b, the same with the empty or outer glumes removed; the flowering glume is awned on the back. (Div. of Agros. U. S. Dept. Agrl.)

It is not common in Iowa, has spread chiefly from fields where it has been introduced as a forage plant. It is, however, of little value as a forage plant in this state.

DISTRIBUTION.

Iowa. Ames, 154 (Ball, Stewart, Sirrine, Hodson).

North America. Naturalized in meadows from Nova Scotia to southern New York, Pennsylvania and Ohio; Michigan and Oregon.

General. Europe, northern Africa, Siberia, Dahuria and western Asia, to northwestern India.

9. SPOROBOLUS.

Sporobolus R. Br. Prodr. 1: 169. 1810. Endlicher. Gen. Pl. 89. Bentham and Hooker. Gen. Pl. 3: 1148. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 49. f. 51. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 73. 1900. (Rev. ed.)

Vilfa Beauv. Agros. 16. pl. 5. f. 8. 1812.

Agrosticula Raddi. Agros. Bras. 33. pl. 1. f. 2.

Triachyrum Hochst. Steud. Syn. Pl. Glum. 1: 186. 1855.

Cryptostachys Steud. Syn. Pl. Glum. 1: 181. 1855.

Diachyrim Griseb. Pl. Lorentz. 209. pl. 2. f. 8. 1874.

Spermachiton Llanos. Frag. Pl. Filip. 25. 1851.

Spikelets small, 1- (rarely 2-) flowered, in an open or contracted or spiked panicle. Lower glumes persistent, 1 to 3-nerved, not awned or pointed, the lower smaller; flowering glume of the same texture as the lower ones (membranaceo-chartaceous) and usually longer than they, naked, awnless and mostly pointless, 1-nerved (rarely somewhat 3-nerved); palea similar, 2-nerved. Stamens chiefly 3. Stigma simply feathery. Grain globular to oblong or cylindrical, deciduous, often very

thin, containing the loose seed. Culms wiry or rigid. Leaves involute, the throat usually bearded, and sheaths often enclosing the panicles. (Name from the Greek word for *seed*, and *to cast forth*.)

Bentham & Hooker give the number of species as 80; the same number is given by Hackel. The species are found chiefly in temperate and tropical America; a few in tropical Africa and Asia.

KEY TO THE SPECIES OF SPOROBOLUS.

Panicle contracted, spike-like.

Spikelets 3.5 mm. long or over.

Plant tall, panicle terminal, flowering glume exceeding the upper empty glume *S. longifolius*.¹

Plant smaller, panicles terminal and lateral, flowering glume equaling the empty glumes *S. vaginaeflorus*.²

Spikelets 3 mm. long or less.

Sheaths inflated, base of panicle usually included *S. neglectus*.³

Sheaths not inflated, panicle exserted *S. cuspidatus*.⁴

Panicle open, pyramidal.

Spikelets about 2 mm. long *S. cryptandrus*.⁵

Spikelets 4 to 5 mm. long *S. heterolepis*.⁶

1. SPOROBOLUS LONGIFOLIUS.

Sporobolus longifolius Wood. Class-book. 775. 1861.

Sporobolus longifolius (Torr.) Wood. Nash in Britton and Brown, Ill. Fl. 1: 151. f. 342. 1896. Scribner. Am. Grasses. Bull. U. S. Dept. Agr. Div. Agros. 7: 126. f. 120. 1900. (3d ed.)

Sporobolus asper Vasey. Contr. U. S. Nat. Herb. 3: 59. 1892. (Not Kunth. Enum. 1: 210. 1833.)

Sporobolus asper Kunth in part. Watson and Coulter. Gray. Man. Bot. 645. 1890. (6th ed.). Scribner. Grasses. Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 72. 1890.

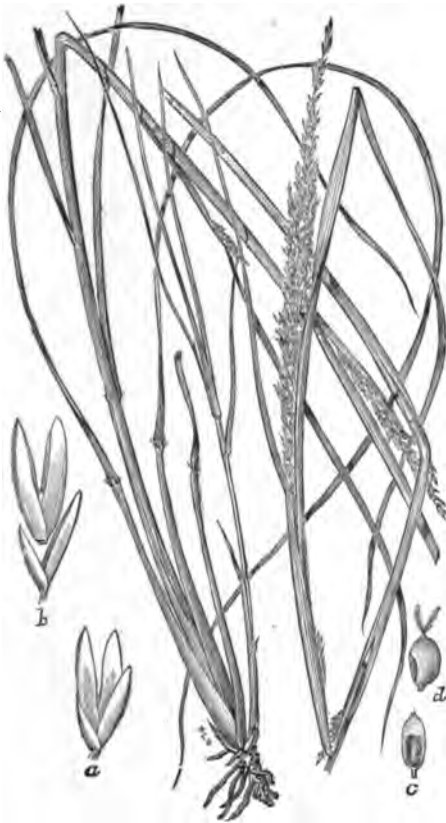


FIG. 111. *Sporobolus longifolius*—a, a spikelet; b, the same with the empty glume separated from the flowering glume; c, grain enclosed by the loose pericarp; d, grain. (Div. of Agros. U. S. Dept. of Agrl.)

DESCRIPTION.

LONG LEAVED RUSH GRASS. A stout perennial, 1 to 3 feet ($3\frac{1}{2}$ -10 dm.) high, with very long, attenuate-pointed leaves, and strict, spike-like panicles 3 to 10 inches (8-25 cm.) long, which are more or less included in the inflated leaf-sheaths. Spikelets 2 to $2\frac{1}{2}$ lines (4-5 mm.) long; empty glumes unequal, scabrous on the keel above, obtuse or subacute; flowering glume scabrous on the keel, obtuse, equalling or a little shorter than the obtuse palea. Dry, sandy soil. August to October

Common on gravelly soils in northern and central and eastern Iowa.

DISTRIBUTION.

Iowa. Slater (Fawcett and Tener), Clinton, Marshalltown, Hawarden, Carnarvon, Carroll, Sioux City, Des Moines 1463, Slater (Pammel); Muscatine (Reppert); Mt. Pleasant (Mills); 776, Tabor (Baldwin); 651, Dixon (Snyder); 106, Ames (Ball); Scott and Muscatine Counties (Barnes and Miller); Sioux City (Miss Wakefield); Greenfield (Stewart); Des Moines (Carver); 1421, Sheldahl (Pammel, Hume and Sample); Boone (Carver); 1462, Sheldahl and Slater (Pammel).

North America. From Maine to Pennsylvania; south to Florida, Tennessee, Alabama, Missouri (St. Louis, Eggert), Texas; west and north to Iowa, Wisconsin, Minnesota, Nebraska (Hastings, Pammel, 280), Dakotas (S. D., Griffith, 71), and Utah.

2. SPOROBOLUS VAGINAEFLORUS.

Sporobolus vaginaeflorus Wood. Class-book. 775. 1861. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 72. f. 92. 1894.

Sporobolus vaginaeflorus. (Torr.) Wood. Nash in Britton and Brown. Ill. Fl. 1: 152. f. 244. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 170, f. 466. 1899.

Sporobolus minor Vasey Watson and Coulter, Gray. Man. 646. 1890. (6th ed.). Contr. U. S. Nat. Herb. 3: 60.

Vilfa vaginaeflora Torr. A. Gray. Gram. and Cyp. 3: 1834.

DESCRIPTION.

SHEATHED RUSH GRASS.

A slender, caespitose annual, 1 to 3 feet ($1\frac{1}{2}$ -4 dm.) high, with very narrow, short leaves, and simple, few-flowered, terminal and axillary, spike-like panicles which are about 1 inch (2 cm.) long, and mostly enclosed in the somewhat inflated leaf-sheaths. Spikelets 1 to 2 lines (2-4 mm.) long. Dry fields and waste places. August-September.

DISTRIBUTION.

Iowa 755, Manchester (Ball); 1014, Carroll (Simon); 711, Forest City (Peters); Muscatine (Reppert); 728, Dixon (Snyder); Lawler (P. H. Rolfs); Cornell (Smith); 750, Dallas Center (Rhinehart); Carroll, Ames, Cedar Rapids, 103 Ames, 225 Carnarvon, Onawa, 126 Carroll, Sioux City, Missouri Valley, Eagle Grove, Mason City (Pammel); Iowa City, Cedar Rapids (Hitchcock); New Hampton (P. H. Rolfs); 1267, Wild Cat Den (Pammel and Reppert); Davenport (Barnes and Miller); Indianola (Carver); Moscow (Hitchcock).

North America. From Vermont, New York, south to North Carolina; Georgia, Tennessee, Mississippi (Starkville, Tracy), Alabama, Texas, Missouri, South Dakota and Wyoming.

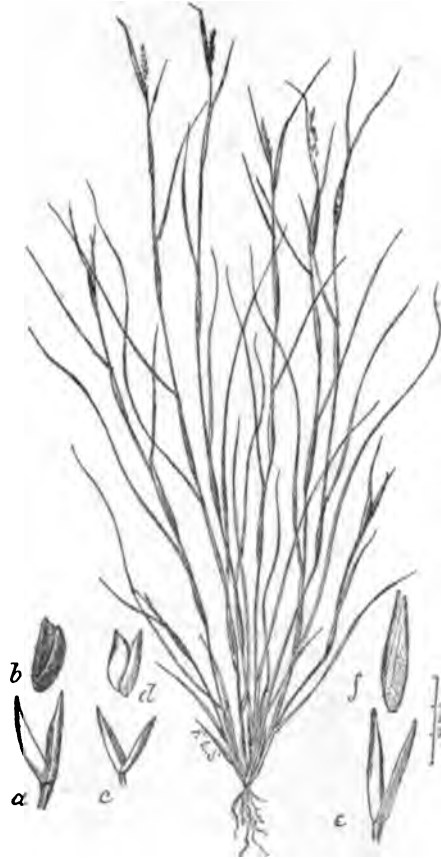


FIG. 112. *Sporobolus vaginaeflorus*—a, empty glume; b, flowering glume and palea. (Div. of Agros. U. S. Dept. Agrl.)

3. SPOROBOLUS NEGLECTUS.

Sporobolus neglectus Nash. Bull. Torr. Bot. Club. 22: 464. 1895.
Nash in Britton and Brown. Ill. Fl. 1: 152. f. 345. 1896.

Sporobolus vaginaeflorus Vasey in Watson and Coulter. Gray. Man. Bot. 645. 1890. (6th ed.). Vasey Contr. U. S. Nat. Herb. 3: 60.

Sporobolus vaginaeflorus. (Torr.) Vasey. Beal. Grasses N. A. 2: 293. 1896. Wood's Class Book 1861. 775 in part.

DESCRIPTION.

SMALL RUSH GRASS. Culms 6 to 12 inches (12-24 cm.) high, erect, from a usually decumbent base, slender, often much-branched, smooth and glabrous. Sheaths about half as long as the internodes, inflated; ligule very short; leaves 1 line (2 mm.) wide or less at the base, smooth and glabrous beneath, scabrous and hairy near the base above, attenuate into a slender point, the lower elongated, the upper 1 to 3 inches (2-6 cm.) long, setaceous; terminal panicle 1 to 2½ inches (2-5 cm.) in length, usually more or less included in the upper sheath, strict; lateral panicles enclosed in the sheaths; spikelets about 1½ lines (3 mm.) long, the outer scales acute, the lower one slightly shorter; third scale acute, glabrous, a little longer than the second, and about equalling the acute palea. August-September.

DISTRIBUTION.

Iowa. 3284 Steamboat Rock, Ames, Sioux City, 1354 Jewell Junction, Hawarden, Boone, 127 Carroll, Carnarvon, 289 Sioux City, 226 Clinton, 172 Ames, Des Moines, Boone (Pammel); Ames (Hitchcock, Bessey, Sirrine, Stewart); Mt. Pleasant (Mills); 750 Dallas Center (Rhinehart); 1420, Sheldahl (Pammel, Hume and Sample); Sioux City (Miss Wakefield); Woodbine (Burgess); Fayette (Fink);

Blue Grass (Barnes); 300, Muscatine (Barnes and Miller); 762, Armstrong (Pammel and Cratty); 631, Parkersburg (Stout); 749, Dallas Center (Rhinehart); 994, Mt. Pleasant (Witte); 997, Glenwood (Jackson); 1078, Emmet County (Cratty); 1055, Armstrong



FIG. 118. *Sporobolus neglectus*—a, spikelet; b, empty glume; c, flowering glume and palea. (Charlotte M. King.)

(Cratty); 763, Ledyard (Pammel and Cratty); Keokuk (Hitchcock); 766, Montrose (Osborn); Greenfield (Stewart); Hamilton to Hancock (Preston); Mason City (Pammel).

North America. From New England south to Kentucky (Harlan County, Kearney); west to Wisconsin (La Crosse, Pammel), Illinois (Eggert; Bluff Lake, Pammel), Kansas, Missouri (St. Louis, Pammel; Plattsburg, Tracy).

4. SPOROBOLUS CUSPIDATUS.

Sporobolus cuspidatus. Wood. Bot. and Fl. 385. 1870.

Sporobolus cuspidatus. Watson and Coulter in Gray. Man. Bot. 646. 1890. (6th ed.) Vasey. Contr. U. S. Nat. Herb. 3: 60.

Sporobolus cuspidatus. Wood. Nash in Britton and Brown. Ill. Fl. 1. 153. f. 347. 1896.

Sporobolus brevifolius. Scrib. Mem. Torr. Bot. Club. 5: 39.

Sporobolus cuspidatus. (Nutt.) Scrib. Beal. Grasses of N. A. 2: 288. 1896.

Agrostis brevifolia Nutt. Gen. 1: 44. 1818. (In part.)

Vilfa cuspidata. Torr. Hooker. Fl. Bor. 2: 238. 1840.

DESCRIPTION.

PRAIRIE RUSH GRASS. Smooth and glabrous, culms 1 to 2 feet (2-5 dm.) tall, erect, simple or somewhat branched. Sheaths shorter than the internodes; ligule a mere ring, $\frac{1}{4}$ line ($\frac{1}{2}$ mm.) long or less, erose-truncate; leaves 1 to 4 inches (2-10 cm.) long, less than 1 line (2 mm.) wide at the base, erect, involute-setaceous, at least when dry; panicle $1\frac{1}{2}$ to 5 inches (3-10 cm.) in length, slender, its branches $\frac{1}{4}$ to 1 inch ($\frac{1}{2}$ -2 cm.) long, appressed; spikelets $1\frac{1}{4}$ to $1\frac{1}{2}$ lines long, the outer scales half to three-quarters as long, acuminate or cuspidate, scabrous on the keel; third scale long-acuminate and cuspidate, sparingly scabrous. In dry soil. August-September.

DISTRIBUTION.

Iowa. Mason City (Pammel); Woodbine (Burgess); 793, Armstrong (Pammel and Cratty); 927, Emmet County (Pammel and Cratty); Carroll, 1027 Kossuth County, Turin, 656 Des Moines, South Dakota opposite Hawarden, 257 Turin Sioux City, 128 Carroll (Pammel); 779, Bartlett (Baldwin); Sioux City (Miss



FIG. 114. *Sporobolus cuspidatus*—a, spikelet. (Charlotte M. King.)

Wakefield); Ames (Sirrinc, Bessey, Hitchcock); Rock Rapids, Lyon County (Shimek); Plymouth County (Brown).

North America. From Manitoba south to Minnesota (Minnehaha Falls, Sandberg), Dakotas (Clements), Iowa, Missouri, Kansas and Nebraska (Paddock).

5. SPOROBOLUS CRYPTANDRUS.

Sporobolus cryptandrus Gray. Man. 576. 1848. Watson and Coulter in Gray. Man. Bot. 646. Vasey. Contr. U. S. Nat. Herb. 3: 62.

Sporobolus cryptandrus (Torr.) Gray. Nash in Britton and Brown. Ill. Fl. 1: 155. f. 353. 1896. Beal. Grasses. N. A. 2: 304. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 160. f. 456.

Agrostis cryptandra Torr. Ann. Lyc. 1: 151. 1824.

Vilfa cryptandra Torr. Steud. Syn. Pl. Glum. 1: 156. 1855. Trin. Mem. Acad. St. Petersburg. VI. 5: 69. 1840.

DESCRIPTION.

SAND RUSH GRASS. An erect, glabrous, caespitose perennial, 4 to 7 dm. high, with flat leaves 6 to 12 cm. long, and open panicles 12 to 20 cm. long. Spikelets 2 to 3 mm. long. Rachilla articulated above the empty glumes, not produced beyond the flower. Glumes 3, round on the back or slightly keeled, awnless, obscurely nerved or nerveless; 2 outer ones unequal; floral glume equalling the empty ones. Palea as long or longer than the flowering glume. Pericarp thin. Annual or perennial grasses with small spikelets; various in habit.



FIG. 115. *Sporobolus cryptandrus*—a, empty glumes; b, flowering glume. (Div. Agros. U. S. Dept. of Agr.)

Iowa. 1922 New Albin, Turin, Sioux City, Council Bluffs (Pammel); Armstrong (Cratty); Hamburg, Iowa City, Moscow, Fremont County (Hitchcock); Ames (Burgess); Moscow (Reppert); Sioux City, Lake Okoboji (Miss Wakefield); Cliffland (Shimek).

North America. From New England to New York, Pennsylvania; Illinois (Graceland, Chicago, Pammel), Wisconsin (La Crosse, D. S. Pammel and C. M. King), Missouri, Iowa, Minnesota, Nebraska (Clements, Grand Island, Broken Bow, Kearney, McCook 390, Crete 378, Pammel), Kansas (Camanche County, Carleton), Texas (Nealley), New Mexico, (Organ Mountains, Vasey 105), Colorado (Golden, Shear; Brighton, Pammel and Stanton; Alamosa, Clements; Denver, Pammel; Northern Colorado, Soldier's Canon, Crandall; Ft. Collins, Pammel); Wyoming (Laramie, Nelson); Montana, Washington, Manitoba, Saskatchewan to New Brunswick.

6. SPOROBOLUS HETEROLEPIS.

Sporobolus heterolepis. Gray. Man. 576. 1848. Watson and Coulter in Gray. Man. Bot. 646. 1890. (6th ed.) Beal Grasses of N. A. 2: 289. 1896. Nash in Britton and Brown. Ill. Fl. 1: 155. f. 354. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 127. f. 121. 1900. (3 ed.) Vasey. Contr. U. S. Nat. Herb. 3: 62.

Vilfa heterolepis. A. Gray. Ann. Lyc. N. Y. 3: 233. 1835. Steud. Synop. Pl. Glum. 1. 157.

DESCRIPTION.

STRONG-SCENTED SPOROBOLUS. A rather stout, somewhat wiry, caespitose perennial, 2 to 3 feet (6-9 dm.) high, with very long and narrow basal leaves and loose, open panicles, 3 to 10 inches (7-25 cm.) long. Spikelets 2 to 2½ lines (4-5 mm.) long; outer glumes very unequal, sharply acuminate-pointed, the first about half the length of the broader second glume, which exceeds the flowering glume in length; flowering glume glabrous, acute or obtuse, as long as the broad palea. In dry soils, prairies, etc. August to September.

Once common on high rolling prairies. Considered a valuable forage plant.



FIG. 116. *Sporobolus heterolepis*—a, spikelets; b, outer glumes; c, d, flowering glumes. (Div. of Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. Mason City (Pammel); Ames (32 Ball, Sirrine, Crozier, Hitchcock, Bessey); Greenfield (Stewart); 2229, Ft. Dodge (Pammel and Sokol); Nora Junction, Rock Rapids, Granite, Spirit Lake (Shimek); Hawarden, Carroll, Carnarvon, 931 Kossuth County, 809 and 741 Kossuth County, 173 Ames, Dakota City, 1296 Jewell Junction (Pammel); 1070 Emmet County (Cratty); Mt. Pleasant (Mills); 1239, Muscatine (Pammel and Reppert); 708 Forest City (Peters); 1054 Emmet County (Cratty); 1054 Armstrong (Cratty); Marshalltown (Stewart); Spirit Lake, Nora Junction (Shimek); Hamilton to Hancock Counties (Preston); Ames (Pammel); State Center (Pammel); Carnforth (Pammel); Steamboat Rock (Miss King); Milford (Shimek).

North America. From Connecticut to Pennsylvania; west to Illinois, Wisconsin, Minnesota (Winona, Holsinger), south through Iowa, Missouri (Jefferson, Webster, Eggert), Texas; Nebraska (Ainsworth, Clements), Wyoming to Assiniboia and Quebec.

10. CINNA.

Cinna L. Sp. Pl. 5. 1753. L. Gen. 15. Endlicher. Gen. Pl. 89. Bentham and Hooker Gen. Pl. 3: 1151. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 50. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 79. f. 67. (Rev. ed.)

Abola Adans. Fam. 2: 31.

Blyttia Fries. Novit. Fl. Suec. Mant. 2: 2.

"Spikelets 1-flowered, much flattened, crowded in an open, flaccid panicle. Empty glumes persistent, lanceolate, acute, strongly keeled, rough-serrulate on the keel; the lower rather smaller, the upper a little exceeding the flower, which is manifestly stalked, smooth and naked; flowering glume much like the lower, longer than the palea, usually

short-awned or mucronate on the back below the pointless apex. Stamen one, opposite the 1-nerved palea. Grain linear-oblong, free." A perennial, rather sweet scented grass, with simple and upright, sward-like culms 2 to 7 feet (5-20 dm.) high, bearing an ample, compound, terminal panicle, its branches in fours and fives; the broadly linear-lanceolate, flat leaves 4 to 6 lines (8-12 mm.) wide, with conspicuous ligules. Spikelets green, often purplish-tinted. (From a Greek word, the name in Dioscorides for a kind of grass.)

Bentham and Hooker and Hackel give the number of species as 2. Both species occur in northern Europe and northern North America.

KEY TO THE SPECIES OF CINNA.

Spikelets 2 mm. long or over, empty glumes unequal.....*C. arundinacea*.¹
Spikelets 1½ mm. long, empty glumes nearly equal*C. latifolia*.²

1. CINNA ARUNDINACEA.

Cinna arundinacea L. Sp. Pl. 5. 1753. Watson and Coulter. Gray. Man. Bot. 649. *pl.* 8. *f.* 1. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 73. *f.* 94. 1894. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 140. *f.* 134. 1900. (3d ed.) Beal. Grasses of N. A. 2: 319. 1896. Nash in Britton and Brown. Ill. Fl. 1: 158. *f.* 360. 1896. Vasey. Contr. U. S. Nat. Herb. 3: 57.

Agrostis Cinna Lamark. Ill. 1: 162. 1791.

Muhlenbergia Cinna. Trin. Dis. 1. 191. 1824.

Blyttia suaveolens Fries. Mant. 2: 2.



FIG. 117. *Cinna arundinacea*—a, b, spikelets; c, same with the empty glumes removed. (Div. of Agros. U. S. Dept. Agrl.)

DESCRIPTION.

INDIAN REED GRASS. A tall, leafy grass, 3 to 7 feet (6-15 dm.) high, with simple culms and ample, terminal panicles. Nodes usually covered by the smooth sheaths; ligule $2\frac{1}{2}$ lines (5 mm.) long, leaf blade spreading, 5 to 10 inches (10-20 cm.) long, 3 to 6 lines (6-12 mm.) wide, scabrous on the margins. Panicles 6 to 15 inches (12-30 cm.) long, rather densely flowered, the branches erect spreading. Spikelets much longer than the pedicels, appressed to the branches (at least in fruit); empty glumes narrow-lanceolate, very acute, unequal, the second longer than the first, and 3-nerved; flowering glume about the length of the second glume, obtuse and hyaline at the tip, 3-nerved, the mid-nerve excurrent just below the apex into a very short awn or mucro. Palea shorter than its glume, 1-nerved and keeled

or sometimes with two closely approximate nerves. July to September.

Cinna arundinacea is most abundant in northern Iowa, occurring in woods. It grows in dense patches, and is an excellent forage plant.

DISTRIBUTION.

Iowa. Mason City, 3130 (Miss King and Brown); Woodbine (Burgess); Steamboat Rock, 3166 and 3027 (Miss King); Columbus Junction 1510, Marshalltown 1080 and 1097 (Pammel); Boone (Carver); Creston (Harsh); Iowa Lake 774, Emmet County 639 (Pammel and Cratty); Ames (Crozier, Kaufman, Bessey, Fisher, Hitchcock); Clinton (Pammel); Greenfield (Stewart); Dallas Center, 921

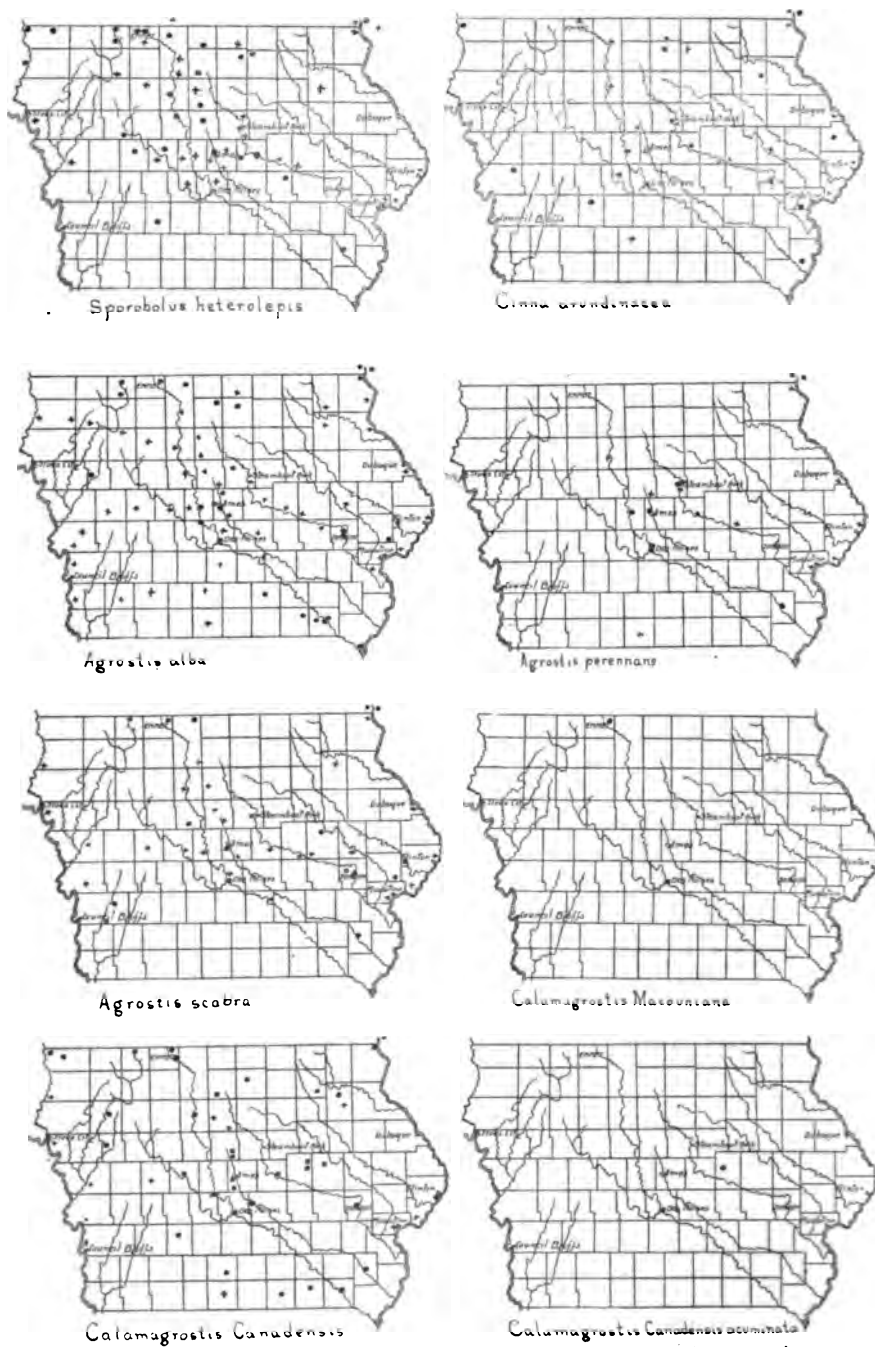


Fig. 118. Distribution of *Sporobolus*, *Cinna*, *Agrostis* and *Calamagrostis*.
 ● Specimens in herbarium. + Localities observed.

(Rhinehart); Fayette (Fink); Lee County (Bartsch); Iowa City (Macbride); Jackson County (Shimek); Steamboat Rock, Pine Creek (Miss King); Granite (Shimek).

North America. From Newfoundland to North Carolina, Alabama, Tennessee; Kentucky (Bell County, Kearney, 375), Ohio (Painsville, Beardslee); north to Texas, Michigan (Farwell, 749); Illinois, Wisconsin (Madison, Rockton, Pammel); Minnesota, Missouri (Eggert), Nebraska and British America.

2. CINNA LATIFOLIA.

Cinna latifolia Trev. in Goepfert. Besch. de. Bot. Gart. Breslau. 82. 1830.

Cinna latifolia Griseb. Ledeb. Fl. Ross. 4: 435. 1853.

Cinna latifolia (Trev.) Griseb. Nash in Britton and Brown. Ill. Fl. 1: 158. f. 361.

Cinna pendula Trin. Mem. Acad. St. Petersb. VI. 6: 280. 1841. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 74. 95. Watson and Coulter. Gray. Man. Bot. 649. 1890. (6th ed.) Vasey. Contr. U. S. Nat. Herb. 3: 57.

Cinna arundinacea (Linn.) var. *pendula* Gray. Man. Bot. 545. (2nd ed.)

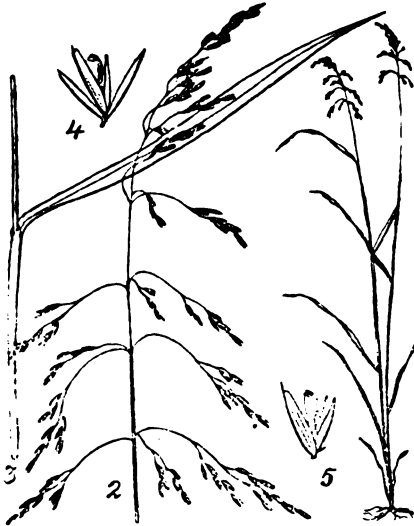


FIG. 119. *Cinna pendula*—2, panicle; 3, upper leaf; 4, spikelet; 5, same with empty glume removed. (Th. Holm Univ. Tenn.)

DESCRIPTION.

SLENDER REED GRASS. Culms rather slender, two to three feet high, leaves and sheaths much as in *C. arundinacea*, but the blades rather more scabrous on the nerves. Panicle lax, often few flowered, the branches capillary and more or less drooping. The glumes less firm than in *C. arundinacea*, and the empty glumes nearly equal, otherwise the same.

DISTRIBUTION.

Iowa. This species has not been found in the state but it ought to occur in the northeastern counties. It is not uncommon in the interior of Wisconsin, especially along the Wisconsin River and other streams, occurring abundantly in shady, damp places.

North America. In damp woods from New Jersey south to North Carolina and Tennessee, through Wisconsin, Minnesota (St. Cloud, Campbell; Grand Rapids, Sandberg); in the Rocky Mountains of Colorado, Utah, Idaho (Kootenai, Sandberg, Heller and McDougall), Washington (Okanogan County, Elmer; Leiberg and Sandberg); Newfoundland (John's Beach, A. Waghorn), Canada (Hastings County, Macoun).

11. AGROSTIS.

Agrostis L. Sp. Pl. 6. 1753. Endlicher. Gen. Pl. 89. Bentham and Hooker. Gen. Pl. 3: 1149. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 50. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 80. f. 58.

Trichodium Michx. Fl. Bor. Am. 1: 41. 1803.

Agraulus Beauv. Agros. 5. 1812.

Chamaecalamus Meyen. Pl. Reise. 1: 456. 1835.

Didymochaeta Steud. Syn. Pl. Glum. 1: 456. 1835.

Spikelets 1-flowered, in an open panicle. Empty glumes somewhat equal, or the lower rather longer, usually longer than the flowering glume, pointless. Flowering glume and palet very thin, pointless, naked the first 3 to 5-nerved, frequently awned on the back; the palet often minute or none. Stamens chiefly 3. Grain (caryopsis) free. Culms usually tufted, slender; root commonly perennial. (Name from Greek, for a *field*, the place of growth.)

One hundred species, mostly cosmopolitan, occurring especially in north temperate regions; Europe 38; Russia 20; North America 33; of which 15 are accredited to Canada; California 14 to 18; eastern states 6 to 8; Rocky Mountains 6 to 8.

KEY TO THE SPECIES OF AGROSTIS.

Palet conspicuous, at least $\frac{1}{2}$ as long as flowering glume.....*A. alba*.¹

Palet inconspicuous, minute or wanting.

Culms weak, usually decumbent at base, leaves lax, spikelets $1\frac{1}{2}$ mm. long.....*A. perennans*.²

Culms and leaves erect.

Panicle branches capillary, elongated, spikelets crowded at ends.

—*A. scabra*.³

Panicle branches not elongated.....*A. intermedia*.⁴

1. AGROSTIS ALBA.

Agrostis alba L. Sp. Pl. 63. 1753. Watson and Coulter in Gray. Man. Bot. 647. 1890. (6th ed.) Scribner Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 78. f. 102. 1894. Beal. Grasses of N. A. 2: 332. 1896. Bull. U. S. Dept. Agrl. Div. Agros. 17: 187. f. 483. 1899. Vasey. Contr. U. S. Nat. Herb. 3: 77.

Agrostis trichodium Michx. Fl. Bor. Am. 1: 41. 1803.

Agrostis vulgaris With. Bot. Arr. Brit. Pl. 132. 1796. (3d ed.)

DESCRIPTION.

RED TOP. A well known perennial of variable habit. Culms smooth, erect or decumbent, and rooting at the base or stoloniferous, 1 to 3 feet (2-9 dm.) high. Sheaths smooth; ligule less than 1 line (2 mm.) to 4 lines (8 mm.) long, sometimes firm and herbaceous at the base; leaf-blade linear or narrow-lanceolate, 4 to 8 inches (8-16 cm.) long, scabrous. Panicle narrow, with erect and rather densely flowered branches, or lax and open, the branches widely spreading, 4 to 10 inches (8-20 cm.) long. Spikelets nearly sessile or pedicellate, 1 to 1½ lines (2-3 mm.) long. Empty glumes lanceolate, acute, the first scabrous on the keel, the second a little shorter, and smooth or scabrous near the apex. Flowering glume a little shorter than the empty ones, obtuse or truncate; palea one-half to three-fourths as long as the glume. Throughout the



FIG. 120 *Agrostis alba*—a, empty glumes; b, floret inclosing stamens. (Div. of Agros. U. S. Dept. of Agri.)

United States, excepting in the extreme south. June to September.

This species is common throughout the state, usually occurring in low grounds. It is an excellent forage plant. The species runs into numerous forms.

DISTRIBUTION.

Iowa. Unionville (Shimek); Ames, (147 Ball, Sirrine, Bessey, Rich and Gessard P. H. Rolfs, 1160 Pammel); 31, Monroe County, Wheatland (Ball); Pilot Mound, 3347 (Miss King and MacCorkindale); Ontario, 3279 (Faurot); Gilbert Station, Boone (Carver); Keokuk, 890 Ledyard, 8 Vernon Center, Minn. (Iowa-Minnesota line, Pammel); 3325 Myron, 3348 and 3354 Postville (Miss King); Alden, 1120 (Stevens); Durant, 1143 (Weaver); Battle Creek, 944 (Preston); Iowa City (Shimek, Macbride); Des Moines, 2254 (Pammel); New Albin, Minn., 904 (Iowa-Minnesota line, Pammel); Armstrong (Cratty); Okoboji, Mason City, High Bridge, Hackberry Grove, Dallas County, Keokuk (Shimek); Morgan Township, Decatur County (Shimek).

North America. From Canada, and especially along the coast, in the mountains of Virginia and North Carolina to Florida; west through Wisconsin, Minnesota, Iowa, Missouri, Tennessee to Texas and the Rocky Mountain region; Colorado (Ft. Collins, Crandall), Wyoming (Carbon County, Big Creek, A. Nelson), Washington (Ellensburg, Elmer); from New Mexico to California and Saskatchewan.

General. Great Britain, Norway, Sweden, south to northern Africa and east to the Himalayas.

2. AGROSTIS PERENNANS.

Agrostis perennans Tuckerm. Am. Journ. Sci. II. 45: 44. 1843. Watson and Coulter. Gray's Man. Bot. 648. 1890. (6th ed.)

Cornucopiae perennans Walt. Pl. Car. 73. 1788.

Agrostis perennans Walt. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 76. f. 97. 1894. Bull. U. S. Dept. Agrl. Div. Agros. 17: 182. f. 478. 1899. Vasey. Contr. U. S. Nat. Herb. 8: 76. Beal. Grasses of N. A. 2: 328. 1896.

DESCRIPTION.

THIN GRASS. A perennial with weak, slender, and mostly decumbent, leafy culms, about 2 feet (5 dm.) high. Internodes short. Sheaths smooth, striate, shorter than the internodes; ligule about 1 line (2 mm.) long; leaf blade flat, thin, widely spreading, about 1 line (2 mm.) wide, 4 inches (8 cm.) long, acute, scabrous. Panicle oblong, about 6 inches (12 cm.) in length; primary branches in clusters of two to five at a node, branched at or below the middle; the branches or pedicels all widely divergent. Spikelets pale green, a line or less long. Empty glumes rather unequal, lanceolate, very acute, rather minutely scabrous on keels. Flower-



FIG. 121. *Agrostis perennans*—a, outer or sterile glume; b, flower. (Div. of Agros. U. S. Dept. of Agrl.)

ing glume a little shorter than empty ones. Damp, shady places. May to September.

DISTRIBUTION.

Iowa. Mt. Pleasant (Mills); Des Moines, Boone (Carver); Ames (Burgess, Pammel); Steamboat Rock, 3171, 3168 and 3053 (Miss King); Ames (Hitchcock); Steamboat Rock, Pine Creek (Miss King); Marshalltown (Pammel); Steamboat Rock (Shimek).

North America. From Quebec, New England, south along the

Atlantic states to Florida; southwest to Texas; Kentucky (Harlan County, Kearney, 381); west to Iowa, Minnesota, Nebraska, Wyoming, Montana, and northward to Winnepeg.

3. AGROSTIS SCABRA.

Agrostis scabra Willd. Sp. Pl. 1: 370. 1798. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 77. f. 99. 1894.

Cornucopiae hyemale Walt. Fl. Car. 73. 1788.

Trichodium laxifolium Michx. Fl. Bor. 1: 42. 1803.

Trichodium scabrum Muhl. Gram. 61. 1817.

Agrostis hyemalis B. S. P. Prel. Cat. N. Y. 68. 1888.

Agrostis hyemalis (Walt.) B. S. P. Beal. Grasses of N. A. 2: 327. 1896. Nash in Britton and Brown. Ill. Fl. 1: 161. f. 368. 1896.

DESCRIPTION.

FLY AWAY GRASS. Usually an annual; erect or somewhat geniculate at the lower joints, 6 inches to 2½ feet (1-6 dm.) high. Sheaths striate, smooth or scabrous; ligules 1 to 2 lines (2-4 mm.) long; leaf-blade erect or ascending, ½ to ¾ line (1-1½ mm.) wide, 2 to 4 inches (4-8 cm.) long, conduplicate when dry, scabrous, especially on the margins and upper surface. Panicles long and lax, the capillary, primary branches two to a node, branched above the middle; the spikelets clustered toward the ends of the ultimate branches. Empty glumes lanceolate, acute, with scabrous keel, about ¾ line (1½ mm.) long, the upper one a little shorter than the lower. Flowering glume rather faintly-nerved, shorter than the empty glumes, awnless or very rarely awned on the back. Palea none. A common grass in dry and sterile, as well as in moist, rich lands. It is the earliest to bloom among our species of *Agrostis*, flowering in May and June.

The species is common throughout the state, frequent in sandy soil but also growing in moist soil and upland prairies.

DISTRIBUTION.

Iowa. Steamboat Rock 3035, Spirit Lake 3365, Ames 3182, Ledyard 1003 (Pammel); Steamboat Rock 3034 and 3044 (Miss King) Marathon 3342 (Roberts); Wheatland, Vinton 21 (Ball); 857, Mt. Pleasant (Mills); Durant, 1140 (Weaver); Ames (Carver); Hamil-

ton County (P. H. Rolfs); Armstrong (Cratty); Johnson County (Shimek); Harcourt (Danielson); Muscatine (Reppert); Cedar Rapids (Shimek); Iowa City (Hitchcock and Macbride).

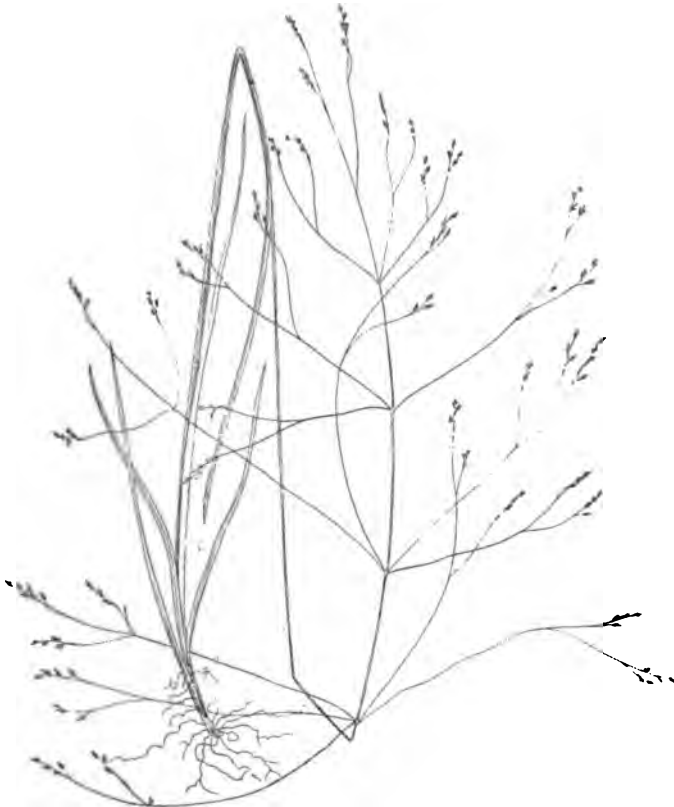


FIG. 122. *Agrostis scabra*—slender branching panicle. (Charlotte M. King.)

North America. Very widely distributed throughout North America, except in the far north; Newfoundland to Manitoba, Athabasca and British Columbia as far north as 60° north latitude; New England to Florida and west to Texas; north through Missouri, Nebraska, Kansas, Iowa, Minnesota, Wisconsin and the Rocky Mountains in California; Colorado (Larimer County, Crandall; Idaho Springs, Rydberg), Wyoming (Yellowstone Park, A. and E. Nelson), and Utah (Uintah Mountains, 10,000 ft., Pammel, Johnson, Buchanan and Lummis).

General. Siberia and Australia.

4. AGROSTIS INTERMEDIA.

Agrostis intermedia Scribn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 76. f. 97. 1894.

DESCRIPTION.

UPLAND BENT GRASS. A slender, perennial grass, 2 feet (5 dm.) high, culms erect, or geniculate at the lower joints. Sheaths smooth, ligules 1 to 3 lines (2-6 mm.) long; leaf-blade 1 to 1½ lines (2-3 mm.) wide, 4 to 6 inches long, scabrous. Panicle oblong, pyramidal, 6 to 8



FIG. 123. *Agrostis intermedia*—a, spikelet; b, sterile glumes; c, stamens and pistil. (Charlotte M. King.)

inches (12-16 cm.) long, with weak and slender branches (as compared with *A. elata*); primary branches in clusters of two to seven at a node, branching again below the middle. Spikelets about 1 line long, scattered above the middle of the branches. Empty glumes thin, sub-equal, lan-

ceolate, acuminate, scabrous on the keels, otherwise smooth. Flowering glume about three-fourths the length of the empty ones. Common in damp places, in thickets and along the borders of woods. August to October.

DISTRIBUTION.

Iowa. It has not been reported to us from the state, though doubtless occurring.

North America. Eastern Atlantic States, Kentucky (Harlan County, Small), and Tennessee; northwest to Iowa and Minnesota.

12. CALAMAGROSTIS.

Calamagrostis Adans. Fam. Pl. 2: 31. 1763. Endlicher. Gen. Pl. 90. Bentham & Hooker. Gen. Pl. 3: 1150, 1152. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 51. f. 54. Scribner. Bull. U. S. Dept. Agri. Div. Agros. 20: 82. f. 60.

Lachnagrostis Trin. Fund. Agr. 128. 1820.

Achaeta Fourn. Gram. Mex. 109. 1880.

Relchela Steud. Syn. Pl. Glum. 1: 101. 1855.

Cinnastrum Fourn. Gram. Mex. 90. 1880.

Deyeuxia Clarion in Beauv. Agros. 43: 1812.

Spikelets 1-flowered, and (in our species) often with a pedicel or rudiment of a second abortive flower (rarely 2-flowered), in an open or spiked panicle. Lower glumes mostly membranaceous, keeled or boat-shaped, often acute, commonly nearly equal, and exceeding the flower, which bears at the base copious, white, bristly hairs; flowering glume thin, bearing a slender awn on the back or below the tip, or sometimes awnless; the palea mostly shorter. Stamens 3. Grain free. Perennials, with running rootstocks, and mostly tall and simple, rigid culms. (Name compounded of two Greek words for *reed* and *grass*.)

Bentham and Hooker include under *Calamagrostis* and *Deyeuxia* 125 species, of which 5 belong to the genus *Calamagrostis*; Hackel recognizes 130 species; this includes the section of *Epigeos* of Koch with 10 species and *Deyeauxia* Beauv. with 120 species. The species are found chiefly in the temperate and colder regions, and mountains of tropical countries, 60 species being found in the Andes region. Beal recognizes 26 species in North America, with six varieties; Kearney recognizes 38 species and 16 varieties.

KEY TO THE SPECIES OF CALAMAGROSTIS.

Panicle open, the branches usually long and lax.

Spikelets 2-2.5 mm. long.....*C. Macouniana*¹.

Spikelets 3-4 mm. long.

Empty glumes ovate-lanceolate, acute.....*C. Canadensis*².

Empty glumes sharp, attenuate-acuminate *C. Canadensis*. var.
*acuminata*³.

Panicle contracted, branches short and strict*C. inexpansa*⁴.

1. CALAMAGROSTIS MACOUNIANA.

Calamagrostis Macouniana Vasey. Contrib. U. S. Nat. Herb. 3: 81.

1892. Beal Grasses of N. A. 2:

343. 1896. Nash in Britton and

Brown. Ill. Fl. 1: 163. f. 372. 1896

Scribner. Bull. U. S. Dept. Agr.

Div. Agros. 17: 196. f. 492. 1896.

Deyeuxia Macouniana Vasey.

Coulter Bot. Gaz. 10: 297. 1885.

DESCRIPTION.

MACOUN'S REED BENT. A slender, erect, leafy perennial, from 1 to 2 feet (3-6 dm.) high, with narrow, flat leaves and narrow or (in anthesis) open, pyramidal panicles 3 to 4 inches (6-8 cm.) long. Spikelets with nearly equal empty glumes, about $1\frac{1}{2}$ lines (3 mm.) long, scarcely exceeding the short-awned, flowering glume. Moist, sandy soil. May to August.

DISTRIBUTION.

Iowa. Emmet County (Cratty).

North America. Assiniboia to Missouri, Montana and Washington.



FIG. 124. *Calamagrostis Macouniana*—a, lower sterile glumes; b, floret with flowering glume, and hairs; c, plumose prolongation of rachilla. (Div. Agros. U. S. Dept. Agr.)

2. CALAMAGROSTIS CANADENSIS.

Calamagrostis Canadensis Beauv. Agros. 15. 1812. Watson and Coulter Gray. Man. Bot. 650. *pl.* 8. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 79. *f.* 104. 1894.

Calamagrostis Canadensis (Michx.) Beauv. Beal. Grasses of N. A. 2: 351. 1896. Nash in Britton and Brown. Ill. Fl. 1: 163. *f.* 373. 1896. Kearney. Bull. U. S. Dept. Agrl. Div. Agros. 11. 28.

Calamagrostis Mexicana Nutt. Gen. 1: 46. 1818.

Arundo agrostoides Pursh. Fl. Am. 86: 1814.

Arundo Canadensis Michx. Fl. Bor. Am. 1: 73. 1803.

Deyeuxia Canadensis Munro. Hook. Trans. Linn. Soc. 23: 345. 1862.

DESCRIPTION.

BLUE JOINT OR RED TOP.

An erect, leafy grass, 3 to 5 feet (7-12 dm.) high, with smooth, simple culms and open, brown or purplish, many-flowered panicles, 4 to 8 inches (9-18 cm.) long. Sheaths smooth, striate; ligule 2 to 3 lines (4-6 mm.) long, membranous; leaf-blade flat, 6 to 18 inches (12-36 cm.) long, 2 to 4 lines (4-8 mm.) wide, tapering gradually into long, filiform tips. Empty glumes ovate-lanceolate, acute, finely strigose, scabrous, awned on the back at or a little below the middle; awn straight, very slender; hairs from the callus as long as the glume. In swamps and wet soils. July to September. A valuable grass in low meadows. Once much more abundant than now. Widely distributed in Iowa.



FIG. 125. *Calamagrostis Canadensis*—a, spikelet with lower, outer glumes to the right of floret. (Charlotte M. King.)

DISTRIBUTION.

Iowa. Ames (Crozier, Stewart, Bessey, Hitchcock); Weaver, 133 (Ball, Zmunt, Fisher); Armstrong (Cratty); Dysart (Miss Sirrine); Belknap, 825 (Rankin); Hamilton County (P. H. Rolfs); Battle Creek, 943 (Preston); Cherokee (Wakefield); Greenfield (Stewart); Spirit Lake, 555 (Ball); Mt. Pleasant, 877 and 1917 (Mills); New Albin 1924, Jefferson 1288, Humboldt 880, Slater (Pammel); Tama County, 275 (Sirrine); Mt. Pleasant, 684 (De Witt); Clinton, 275 (Ball); Decatur County (Fitzpatrick); West Union, 1441 (Whitmore); Colfax (Mead); Emmet County, 1062 (Cratty); Iowa City (Hitchcock); Hamilton County (P. H. Rolfs); Marshalltown (Eckles); minor form, Armstrong (Cratty); Vinton, 13 and 1251 (Ball); Afton Junction (Miller); Clear Lake, High Bridge, Dallas County, Cedar Rapids, northwest corner of state, Lyon County (Shimek); Hamilton to Hancock County (Preston); Keosauqua (Shimek).

North America. Canada (Carson); from Maine south to New Jersey, Ohio, Iowa, Minnesota (St. Cloud, Campbell; Silver Creek, Sandberg), Illinois (Palatine, Pammel), Wisconsin (La Crosse, Pammel; St. Croix, Parry); Missouri (Carson Station, Eggert); Nebraska (North Platte, Pammel); Colorado (Ft. Collins, Crandall; Idaho Springs, Shear); Wyoming (Laramie Hills, A. Nelson); Montana (Craig); Utah (Uintah Mountains, Lamotte Peak, Pammel, Johnson, Buchanan and Lummis), to British Columbia.

3. CALAMAGROSTIS CANADENSIS VAR. ACUMINATA.

Calamagrostis Canadensis var. *acuminata* Vasey Bull. U. S. Dept. Agr. Div. Agros. 5: 26. 1897. Kearney. Revision of the N. Am. Species of *Calamagrostis*. Bull. U. S. Dept. Agr. Div. Agros. 11: 29. 1898.

Calamagrostis Canadensis var. *robusta* Vasey in Wheeler Rep. 6: 285.

DESCRIPTION.

SHARP POINTED RED TOP. Sheaths rarely inconspicuously bearded at junction with blade; blade usually short, scabrous-pubescent on the upper (rarely both) surfaces; panicle commonly rather small, more flexuous and more densely flowered than the species, usually dark purple; spikelets larger, $1\frac{3}{4}$ to 2 lines (3.5-4 mm.) long; empty glumes comparatively narrow, sharp, attenuate, acuminate; sometimes subfalcate, somewhat thicker, usually much more scabrous (occasionally almost strigose); longer, often considerably (sometimes $\frac{1}{4}$ line (.5 mm.)) exceeding the flowering glume.



FIG. 128. *Calamagrostis Canadensis* var. *acuminata*—a, spikelet; 1 and 2 empty glumes, 3 flower; b, flower, 1 flowering glume, 2 palea. (Charlotte M. King.)

DISTRIBUTION.

Iowa. Most abundant in northern Iowa; Tama County 962 (Sirrine).

North America. Labrador and Newfoundland to Iowa; high mountains of North Carolina; Keewatin to Alaska, south in the mountains to New Mexico and California; Montana (Spanish Creek, Vasey), Wyoming (Yellowstone Nat. Park, A. and E. Nelson, 6166; West Branch of Big Goose River, Pammel and Stanton); Washington (Okanagan County, Elmer); Utah (Provo Canon, Pammel and Stanton, 203); Colorado (Walcott, 6975 ft., Shear and Bessey, 1310).

4. CALAMAGROSTIS INEXPANSA.

Calamagrostis inexpansa Gray. Gram. et Cyp. 1. No. 20: 1834. Scribner. Am. Grasses. Bull. U. S. Dept. Agr. Div. Agros. 17: 191. f. 487. 1900. (3 ed.)

Calamagrostis confinis Nutt. Gen. 1: 47. 1818. Watson and Coulter. Gray. Man. Bot. 650. 1890. (6 ed.)

Calamagrostis neglecta var. *confinis* (Willd.) Beal. Grasses. of N. A. 2: 353. 1896.

Calamagrostis confinis (Willd.) Nutt. Nash in Britton and Brown Ill. Fl. 1: 165. f. 377. 1896.

Calamagrostis confinis inexpansa Gray. Kearney. Bull. U. S. Dept. Agr. Div. Agros. 11: 37. 1898.

DESCRIPTION.

BOG REED GRASS. A slender, erect perennial, $1\frac{1}{2}$ to $4\frac{1}{2}$ feet (3-9 dm.) high, with narrow, flat leaves and contracted panicles $2\frac{1}{2}$ to 9 inches (5-18 cm.) long. Spikelets $1\frac{1}{2}$ to 2 lines (3-4 mm.) long with nearly equal, acute empty glumes about the length of the flowering glumes, the basal hairs of which nearly equal it in length or are one-third shorter. Damp, sandy soil. August to September.

This species is not infrequent in northern Iowa, especially in Dickinson, Humboldt, Emmet and Kossuth Counties. Probably extends as far south as Hamilton County. The species grows in low grounds, borders of shallow streams, borders of lakes, and in marshy places.



FIG. 127. *Calamagrostis inexpansa*—a, empty glumes; b, flowering glumes with basal hairs; c, tuft of hairs at base of flowering glume. (Div. of Agros. U. S. Dept. of Agr.)

DISTRIBUTION.

Iowa. Manly (Williams); Armstrong (Cratty); Humboldt, 1286 (Pammel); Emmet County, 1929, 1920 (Ledyard), 3223 (Gridley), 3266 and 3263 (Armstrong); Elmore, Minn. (Iowa and Minnesota line), 915 (Pammel); Lyon County (E. D. Ball).

North America. Damp, sandy soil, New York (Lake George, Vasey), New Jersey, westward to Minnesota (DeSoto Lake, Sandberg), South Dakota, Colorado (Veta Pass, Vasey), and Wyoming (Clear Creek, Griffith and Williams).

13. CALAMOVILFA.

Calamovilfa Scribner in Hack. True Grasses. 113. 1890. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 84. *f. 62.* (Rev. ed.)

Ammophila Host. Gram. Aust. 4: 24. *pl. 41.* 1809. Endlicher. Gen. Pl. 90. Bentham and Hooker. Gen. Pl. 3: 1153.

Psamma Beauv. Agros. 143. 1812.

Calamagrostis sec. *Calamovilfa* A. Gray. Man. Bot. Northern U. S. 616 (5 ed.)

Rudiment of second flower wanting; glumes and palet rather chartaceous, compressed-keeled; flowering glume 1-nerved, entirely awnless; palet strongly 2-keeled; panicle at length open and loose.

There are three living species. Native to the temperate and sub-tropical regions of North America. The related sea-sand reed, *Ammophila*, is distinct. There are two species of *Ammophila* widely distributed among the salt water shores of the northern hemisphere. Valuable as a sand binder.

1. CALAMOVILFA LONGIFOLIA.

Calamovilfa longifolia Hack. True Grasses. 113. 1890.

Calamagrostis longifolia Hook. Fl. Bor. Am. 2: 241. 1840. Watson and Coulter. Gray. Man. Bot. 651. 1890. (6 ed). Vasey Contr. U. S. Nat. Herb. 3: 84.

Calamagrostis longifolia (Hook) Hack. Beal. Grasses of N. A. 2: 355. 1896. Nash in Britton and Brown. Ill. Fl. 1: 167. f. 382. 1896.

DESCRIPTION.

LONG LEAVED REED GRASS. Culms 2 to 6 feet (4-12 dm.) high, stout, from thick, running rootstocks; leaves rigid, elongate, involute above and tapering into a long, thread-like point; ligule consisting of a ring of hairs 1 line (2 mm.) long; panicle at first close, becoming open and pyramidal, the branches smooth; glumes lanceolate, the upper as long as the flower, the lower $\frac{1}{4}$ shorter; the copious hairs more than half the length of the naked flower.



FIG. 128. *Calamovilfa longifolia*—a, spikelet; b, empty glumes; c, flower. (Charlotte M. King.)

DISTRIBUTION.

Iowa. Sioux City (Miss Wakefield); Ames (Hitchcock); Emmet County, Armstrong, 1116 (Cratty); Hawarden, Sioux City, Turin, 187 (Pammel); Lyon County, Rock Rapids, 49, 39 (Shimek); Hull (Newell); Hamburg (Hitchcock).

North America. Sands, along the upper Great Lakes from Illinois (Shores Lake Michigan, Chicago, Pammel; Graceland, Pammel), and Michigan to Manitoba, South Dakota (Griffith, 753; Hot Springs, Rydberg, 131); Nebraska (Long Pine, C. F. Curtiss; Ravenna, Pammel; McCook, Pammel, 367); Kansas, Colorado (La Porte, Cache La Poudre River, Pammel and Johnson, 1597 and 1742; Ft. Collins, Crandall).

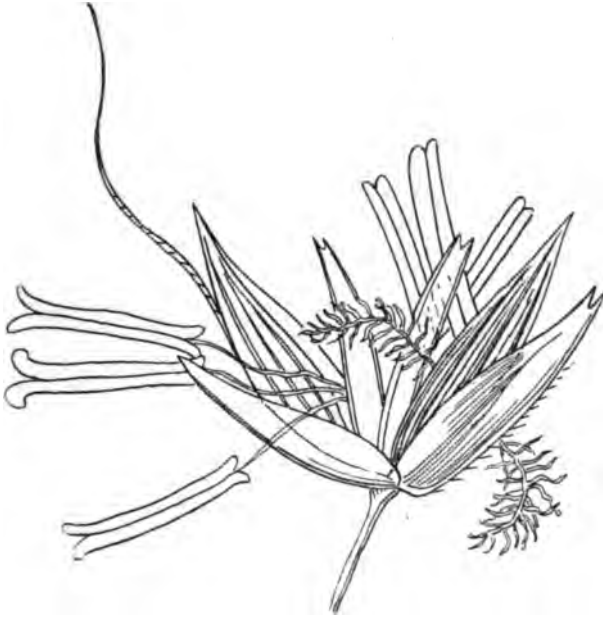


FIG. 129. Flower of *Arrhenatherum avenaceum*. (Charlotte M. King.)

TRIBE IX.—AVENEAE.

Spikelets 2 to several-flowered; outer, empty glumes usually longer than the first floral glume; one or more of the flowering glumes awned on the back or from between the teeth of the bifid apex; awn usually twisted or geniculate; the callus, and usually the joints of the rachilla, hairy.

A tribe comprising 23 genera and over 300 species, widely distributed in the temperate regions of both the Old and the New World, particularly abundant in South Africa and Australia, a few extending beyond the Arctic Circle.

Several of the species are of economic value as forage plants. Tall meadow oat grass (*Arrhenatherum avenaceum*) and velvet grass or mesquite, as it is known in Oregon and Washington, both introduced from Europe, are grasses of much agricultural value, especially the first named. Tufted hair grass (*Deschampsia caespitosa*), a common grass in the Rocky Mountains of the west and northwest, is of some local value as a forage plant, especially for low, wet soils. Cultivated oats (*Avena sativa*), used largely in the south and on the Pacific coast for pasturage and hay, and generally cultivated as a cereal, is the best known example of this tribe.

KEY TO THE GENERA OF THE AVENEAE.

Pedicels of the spikelets articulated below the empty glumes, spikelets deciduous, plant velvety.....*Holcus*.¹.

Pedicels not articulated below the empty glumes, which are persistent.

Awn of the flowering glume dorsal, inserted below the teeth.

Flowers all perfect, or the upper ones staminate or sterile.

Grain sulcate, hairy at the apex.....*Avena*.².

Lower flower staminate, its glume strongly awned; the upper perfect*Arrhenatherum*.³.

Awn of the flowering glume inserted between the teeth. *Danthonia*.⁴.

1. HOLCUS.

Holcus L. (in part) Sp. Pl. 1047. 1753. Endlicher. Gen. Pl. 81. Bentham and Hooker Gen. Pl. 3: 1159. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 53. f. 57. Beauv. Agrost. 87. pl. 17. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 89. f. 65.

Spikelets crowded in an open panicle, 2-flowered; the boat-shaped, membranaceous glumes enclosing and much exceeding the remotish flowers. Lower flower perfect, its papery or thin, coriaceous glume awnless and pointless; the upper flower staminate, otherwise similar, but bearing a stout, bent awn below the apex. Stamens 3. Styles plumose to the base. Grain free. (A name in Pliny for a kind of grass, from a Greek word for *attractive*, of obscure application.)

Eight species according to Bentham and Hooker; found chiefly in Europe and northern Africa, one, however, reaching the Cape region.

HOLCUS LANATUS.

Holcus lanatus L. Sp. Pl. 1048. 1753. Watson and Coulter. Gray. Man. Bot. 652. pl. 12. 1890. (6 ed.). Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. 7: 81. f. 106. 1894. Bull. U. S. Dept. Agrl. Div. Agros. 7: 157. f. 151. 1900. (3 ed.) Beal. Grasses of N. A. 2: 360. 1896. Nash in Britton and Brown. Ill. Fl. 1: 168. f. 384. 1896.



FIG. 190. *Holcus lanatus*—a, spikelet; b, flowering glumes; c, ligule. (Div. Agros. U. S. Dept. Agrl.)

DESCRIPTION.

VELVET GRASS. A perennial grass, 1 to 2 feet (2-4 dm.) high, from a creeping rhizome; usually closely pubescent all over with soft whitish hairs. Panicle 2 to 3 inches (4-6 cm.) long, pale or sometimes purpletinged. Spikelets about 2 lines (4 mm.) long, obtuse; the second empty glume broader than the first, three-nerved and often short-awned at the apex, both ciliate on the prominent keels, and thinly pubescent all over; lower floral glume smooth and shining, becoming indurated in fruit. Introduced from Europe. May to August. The species has been introduced in a few places. It rarely persists.

DISTRIBUTION.

Iowa. Ames (Weaver); Ames, 1118 (Carver).

North America. Widely naturalized from New England states, Massachusetts (Boston, Waverly, Pammel), New York (Washington County, Parry), south to Tennessee and Alabama, and occasionally northward; also upon the Pacific Coast and British America. Washington (Cape Disappointment, Parry).

General. Great Britain, on the continent of Europe, northern Africa and Siberia.

2. AVENA.

Avena L. Sp. Pl. 79. 1753. Endlicher. Gen. Pl. 96. Benth. and Hook. Gen. Pl. 8: 1160. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 94. f. 70. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 55. f. 63.

Spikelets 2 to many-flowered, paniced; the flowers herbaceo-char-
taceous or becoming harder, of firmer texture than the large and mostly
unequal, empty glumes; the uppermost flower imperfect; rachis and base
of the flower often bearded. Flowering glume rounded on the back,
mostly 5 to 11-nerved, bearing a long, usually bent or twisted awn on
the back between the two acute teeth at the apex, proceeding from
the mid-nerve only. Stamens 3. Grain oblong-linear, grooved, on one
side, usually hairy, at least at the top, free, but invested by the palea.
(The classical Latin name.)

Species 40 (Bentham & Hooker); 50 (Hackel); by some the number
has been reduced to 30. Mostly in temperate regions of the Old World
and sparingly in the New World. United States is credited with two
or three naturalized, and eight native species. One species, the *A. fatua*,
is widely naturalized on the Pacific Coast, Rocky Mountains and spar-
ingly on the Atlantic Coast, Wisconsin, Minnesota and northeastern
Iowa.

KEY TO THE SPECIES OF AVENA.

Flowering glume glabrous or hairy at the base only, cultivated

— *A. sativa*.¹.

Flowering glume hairy to or beyond the middle..... *A. fatua*.².

1. AVENA SATIVA.

Avena sativa L. Sp. Pl. 79. 1753. Scribner. Grasses of Tenn. Bull.
Univ. Tenn. Agr. Exp. Sta. 7: 83. f. 110. 1894. Beal. Grasses of N. A. 2:
385. 1896.

¹Flowering glume less hairy than *A. fatua*, softly pilose.

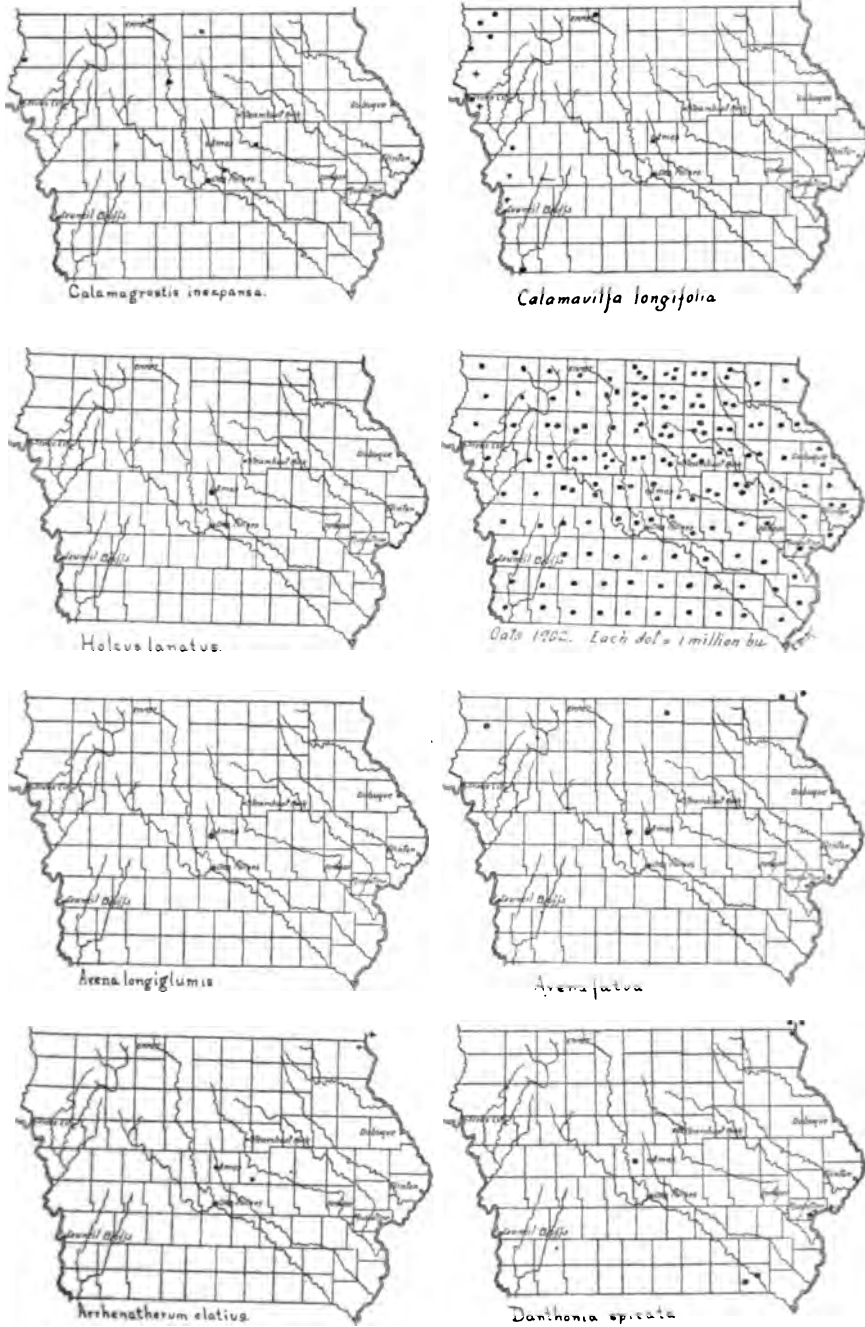


FIG. 181. Distribution of *Calamagrostis*, *Calamovilfa*, *Holcus*, *Avena*, *Arrhenatherum* and *Danthonia*.
 ● Specimens in herbarium. † From observation.

DESCRIPTION.

COMMON OATS. A well known, erect annual, 2 to 4 feet (5-10 dm.) high, with flat leaves and expanded panicles of rather large, pendulous and usually two-flowered spikelets. Lower florets sometimes awned. Oats is commonly cultivated in all sections of Iowa. Its culture is, however, most successful in the northern part of the state.

DISTRIBUTION.

Iowa. Ames (Hodson); Fairfield (Rich and Gossard); Webster City (Pammel); Manchester (Hoyt); Cedar Rapids (Miss Hall); Alden, 1125 (Stevens); Calhoun County (Rigg); Johnson County (Shimek); Marshalltown (Pammel).

North America. Widely cultivated in northern United States, British Columbia, especially in the northern and eastern sections, and along the Pacific Coast.

General. This species is native to eastern temperate Europe, and western Asia, although the wild form has not been found. According to some authors, cultivated oats originated from wild oats (*Avena fatua*). This is very doubtful.



FIG. 182. *Avena sativa*—showing panicle.

2. AVENA FATUA.

Avena fatua L. Sp. Pl. 80. 1753. Watson and Coulter. Gray. Man. Bot. 653. 1890. (6 ed.) Nash in Britton and Brown. Ill. Fl. 1: 173. f. 395. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 203. f. 499. 1899.

Avena barbata Brot. Beal. Grasses of N. A. 2: 383. 1896.



FIG. 133. *Avena sativa*—a, empty glumes; b, flowering glumes; (Div. Agros. U. S. Dept. of Agr.)

DESCRIPTION.

WILD OATS. An erect, glabrous annual, 3 to 5 feet (6-12 dm.) high, with flat leaves and spreading panicles of large, oat-like, nodding spikelets. Spikelets 2 to 4-flowered, with empty glumes $\frac{3}{4}$ to 1 inch ($1\frac{1}{2}$ -2 cm.) long, and pubescent flowering glumes 6 to 9 lines (12-18 mm.) long. Awns nearly twice as long as the spikelets. Fields and waste places from Wisconsin westward; abundant in grain fields on the Pacific slope. June to September.

Locally wild oats is abundant, especially in northeastern Iowa and southwestern Wisconsin. It is highly esteemed as a forage plant, especially in California. It is a bad weed, however, in grain fields.

DISTRIBUTION.

Iowa. Houston County, Minn. 5 Minnesota-Iowa line (Pammel); Ames, 119 (Ball); Boone (Carver); Hull (Newell).

North America. In fields and waste places, especially common along the Pacific coast and the irrigated districts of the Rocky Mountain region. Oregon (Howell), California (Parry; Auburn, Pammel, 1), Colorado (Ft. Collins, Pammel), Wyoming (Buffalo, Griffith and Williams, 126); also in the Dakotas (N. D., Fargo, Bolley), Minnesota, Wisconsin and Iowa.

3. AVENA LONGIGLUMIS.

Avena longiglumis Durien Duch. Rev. Bot. 1: 395. 1845-46 Steud. Syn. Fl. Gram. 233.

DESCRIPTION.

LONG GLUMED WILD OATS. Annual, with leaves and sheaths lightly pilose; truncate ligule with short, hairy fringe; lower part of panicle drooping; spikelets three-flowered; empty glumes far exceeding the floret, and both alike 9-nerved; very pilose rachilla jointed, lower joint persistent, florets from base beyond the middle softly pilose; glumes slightly unequal, upper 7-nerved, awned a little beyond the middle with two very long, bristly hairs, more than half as long as the glume; the lower with the linear apex two-toothed. Algeria. Introduced on the college grounds but not persistent.

Iowa. Ames (Bessey); Ames (cult.).



FIG. 134. *Avena longiglumis*—a, spikelet: 1, empty glume; 2, flowering glume; 3, rudimentary spikelet. (Charlotte M. King.)

3. **ARRHENATHERUM.**

Arrhenatherum Beauv. Agrost. 55. *pl.* 11. *f.* 5. 1812. Endlicher Gen. Pl. 96. Bentham and Hooker. Gen. Pl. 3: 1161. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 56. *f.* 64.

Avena Host. Gram. Austr. 2: *pl.* 49. 4: *pl.* 30. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 95. *f.* 71. (Rev. ed.)

Spikelets open-panicked, 2-flowered, with the rudiment of a third flower; the middle flower perfect, its glume barely bristle-pointed from near the tip; the lowest flower staminate only, bearing a long, bent awn below the middle of the back; otherwise as in *Avena*, of which it is only a peculiar modification. (Name from two Greek words for *masculine* and *awn*.)

Bentham and Hooker give the number of species as 3; the same number is given by Hackel, although some authors give the number as 6. Native to Europe, northern Africa and western Asia; one species widely cultivated in eastern North America, and naturalized to a considerable extent on the Pacific coast.

ARRHENATHERUM AVENACEUM.

Arrhenatherum avenaceum Beauv. Agrost. 152. 1812. Watson and Coulter. Gray. Man. Bot. 652. *pl.* 12. 1890. (6 ed.)

Arrhenatherum elatius Beauv. Scribner. Grasses. of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 83. *f.* 109. 1894.

Arrhenatherum elatius (L.) Beauv. Nash in Britton and Brown. Ill. Fl. 1: 173. *f.* 396. 1896. Bull. U. S. Dept. Agrl. Div. Agros. 7: 173. *f.* 167. 1900, (3 ed.). Beal. Grasses N. A. 2: 387. 1896.

Avena elatior L. Sp. Pl. 79. 1753.

DESCRIPTION.

OAT GRASS. A tall, perennial grass, 2 to 4 feet (5-10 dm.) high, rather sparingly leafy, with a narrow, terminal, many-flowered panicle, 6 to 12 inches (1½-3 dm.) long; the branches spreading during flowering. Spikelets 4 to 5 lines (8-10 mm.) long, the second glume larger than the first, three-nerved and about equalling the florets. Awn geniculate near the middle, closely twisted below, divergent above. Grain pubescent, enclosed within the fruiting glume and palea, but free from them. In fields and waste places, Maine and Ontario to Georgia and Tennessee, also on the Pacific coast. June to August. Tall meadow oat grass has escaped from cultivation in different parts of the state. It has never met with much favor as a forage plant among the farmers of the state.



FIG. 185. *Arrhenatherum avenaceum*—a, spikelets; b, flowering glumes. (Div. Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. Ames, 143 (Ball, Sirrine, P. H. Rolfs, Van Cleve, War-den.

North America. Widely introduced on the Pacific and Atlantic coasts; from New England, District of Columbia (Washington), North Carolina (Small and Heller) to Georgia; east to Tennessee and south to Alabama; occasionally north in Wisconsin, Michigan and the Rocky Mountain region; common on the Pacific coast; Colorado (Ft. Collins, Crandall).

General. Europe, northern Africa, western Asia, said to be a troublesome weed in Great Britain.

4. DANTHONIA.

Danthonia D. C. Fl. Fr. 3: 32. 1805 Endlicher. Gen. Pl. 97. Bentham and Hooker. Gen. Pl. 3: 1162. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 56.

Pentameris Beauv. Agros. 92. 1812. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 96. f. 72. (Rev. ed.)

Streblochaeta Hochst. Pl. Schimp. Abyss. n. 412. 1835.

Triaphis Nees. Pl. Afr. Austr. Glum. 270. 1841.

Chaetobromus Nees. Lindl. Ind. Nat. Syst. 449. 1835. (2 ed.)

Flowering glume oblong or ovate, rounded, cylindricaceous, 7 to 9-nerved, bearing, between the sharp-pointed or awn-like teeth of the tip, an awn, usually composed of the three middle nerves, which is flattish and spirally twisting at the base; otherwise as in *Avena*. Empty glumes longer than the imbricated flowers. Ours perennial, 1 to 2 feet (2-5 dm.) high, with narrow and soon involute leaves, hairy sheaths bearded at the throat, and a small, simple panicle or raceme of about 1-flowered spikelets. (Named for Danthoine, a French botanist.)

Bentham & Hooker give the number of species at 100; the same number is given by Hackel. In the temperate and warmer regions of both hemispheres; more than half are native to South Africa, of which Beal describes 7; native to Australia 7.

1. DANTHONIA SPICATA.

Danthonia spicata Beauv. in R. and S. Syst. 2: 690. 1817. Watson and Coulter. Gray. Man. Bot. 654. pl. 12. f. 1-3. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. U. S. Dept. Agr. Div. Agros. 7: 85. f. 113. 1894.

Danthonia spicata (L.) Beauv. Beal. Grasses of N. A. 2: 391. f. 68. 1896. Nash in Britton and Brown. Ill. Fl. 1: 174. f. 397. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 1: 7: 174. f. 168. 1900. (3 ed.)

Avena spicata L. Sp. Pl. 119. 1753.

DESCRIPTION.

WILD OAT GRASS. A smooth, slender, erect grass, 10 to 20 inches (23-45 cm.) high, with a small, narrow panicle, the short branches of which spread only in flower. Sheaths glabrous, bearded at the throat; basal leaves numerous, usually involute, and curled or recurved; those of the culm shorter, 1 line (2 mm.) wide or less, glabrous or pilose. Panicle 1 to 2 inches (2½-5 cm.) long, simple, few-flowered, the short branches usually erect. Empty glumes 4 to 6 lines (8-12 mm.) long, exceeding the florets, lanceolate, acute, three-nerved below; with broad, scarious margins; flowering glume about 2 lines (4 mm.) long, sparingly pilose on the rounded back and along the margins below; callus glabrous; apex of the flowering glume ending in two short, usually blunt teeth. Common in dry, thin soils. June to September.

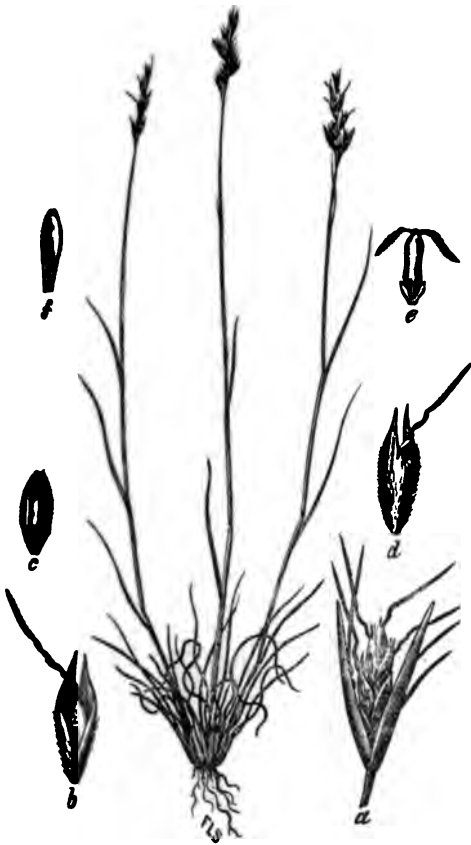


FIG. 136. *Danthonia spicata*—a, spikelet; b, flower; c, flowering glume; d, empty glume. (Div. Agros. U. S. Dept. Agr.)

Wild oat-grass is found only in a few, isolated localities in central and eastern Iowa; most frequently in the southeastern part of the state.

DISTRIBUTION.

Iowa. Lebanon, 25 (Ball and Sample); Steamboat Rock, Ledges, Boone County (Pammel); Wild Cat Den (Barnes); Cliffland, Pittsburg (Shimek); Steamboat Rock (Shimek).

North America. Atlantic coast, New Jersey (Woodbridge Twp., Middlesex County, Lightpipe), West Virginia (Little Falls, Mills-paugh), Georgia (DeKalb Mt.); south to Florida; west to Ohio (Worthington and Baltimore; A. Bigelow), Illinois (Fulton, Wolfe; Lake View, Pammel), Wisconsin (Pammel), Minnesota (Itaska Lake, Sandberg), Iowa, Missouri (St. Louis, Eggert; Washington, and Crystal City, Pammel), Arkansas (Harvey), Wyoming (Yellowstone Nat. Park, Norris; 6140, A. and E. Nelson).

TRIBE X.—CHLORIDEAE.

Spikelets 1 to several-flowered, in one-sided spikes or racemes; the racemes digitate or fasciculate, rarely solitary; flowering glumes usually keeled, entire and unawned, or toothed, and with 1 to 3 (rarely more than 3) straight awns.

A small tribe of 27 genera and 155 species, characterized chiefly by the inflorescence, which is nearly that of *Paspalum*. The awns, when present, are not dorsal or twisted, as in the *Agrostideae* and *Aveneae*. Chiefly natives of tropical and subtropical countries; a few are widely distributed as weeds throughout the warmer parts of the world. A number are good turf-forming grasses and are valued for grazing purposes. One of these is the celebrated buffalo grass of the western plains, which is remarkable for having the staminate and pistillate spikelets separate and in unlike inflorescences, either upon the same plant (monoecious) or upon different plants (dioecious). Bermuda grass, and the Gramas of the southwest belong to this tribe.



FIG. 137. Flower of *Spartina cynosuroides*. (after Gray.)



FIG. 138. Flower of *Bouteloua curtipendula*. (after Gray.)

KEY TO THE GENERA OF THE CHLORIDEAE.

Flowers perfect. Spikelets all alike.

One perfect flower in each spikelet.

No sterile glumes above the flower.

Spikes digitate, slender; a creeping perennial... *Cynodon*.¹

Spikes racemose.

Spikelets globose..... *Beckmannia*.²

Spikelets lanceolate.

Spikes thick, pectinate; stout, erect perennials

— *Spartina*.³

Spikes slender; low, diffuse annuals

— *Schedonnardus*.⁴

- Several sterile glumes above the flower.....*Bouteloua*.⁵.
 Two to three perfect flowers in each spikelet.....*Eleusine*.⁶.
 Flowers unisexual; spikelets dioecious, the staminate and pistillate
 very different.....*Buchloe*.⁷.

1. CYNODON.

Cynodon Rich. Pers. Syn. 1: 85. 1805. Endlicher. Gen. Pl. 92. Bentham & Hooker. Gen. Pl. 3: 1164. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 58. f. 67. Pers. Syn. Pl. 1: 85. 1805. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 99. f. 73.

Capriola Adans. Fam. 2: 31. 1763.

Fibichia Koel. Gram. Gall. & Germ. 308. 1802.

Spikelets 1-flowered, with a mere naked, short-pedicelled rudiment of a second flower, imbricate-spiked on one side of a flattish rachis; the spikes usually digitate at the naked summit of the flowering culms. Empty glumes keeled, pointless, rather unequal; flowering glume and palea pointless and awnless, the glume large, boat-shaped. Stamens 3. Low, diffusely branched and extensively creeping perennials, with short, flattish leaves. (Name compounded from two Greek words for *tooth* and *dog*.)

Four species distributed throughout the tropical and temperate regions of the world. The Bermuda grass, *Cynodon Dactylon*, is widely naturalized.

1. CYNODON DACTYLON.

Cynodon Dactylon Pers. Syn. Pl. 1: 85. 1805. Watson and Coulter. Gray. Man. Bot. 654. pl. 9. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 86 f. 115. 1894.

Capriola Dactylon (L.) Kuntze. Beal. Grasses of N. A. 2: 335. 1896. Nash in Britton and Brown. Ill. Fl. 1: 175. f. 400. 1896.

Cynodon Dactylon Pers. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 177. f. 171. 1900. (3 ed.)

DESCRIPTION.

BERMUDA GRASS.

Stems prostrate and extensively creeping, with numerous, ascending or upright, leafy and flower-bearing branches. Sheaths smooth, hairy at the throat. Leaves flat, widely spreading, gradually tapering to a very slender, acute tip. Spikelets three to five, slender, widely spreading, often purplish, 1 to 2 inches (2-4 cm.) long. Flowering glume broadly boat-shaped, about 1 line (2 mm.) long, usually ciliate on the keel. Widely dispersed in the southern States. June to October.

Occurs as a cultivated plant only. It was cultivated in Iowa in 1889 and 1890 and persisted one season. Since then it has not been found.



FIG. 139. *Cynodon Dactylon*—a, spikelet; b, flowering glumes. (Div. Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. Ames, cult. (Pammel); Sioux City, cult. (Bandusia Wakefield).

North America. From New York, south along the Atlantic coast, through Tennessee, South Carolina (A. P. Anderson), Louisiana (Ball, 1); west through Alabama and Texas; Cuba (Santa Clara Province, Combs, 540); also along the Pacific coast, California (Santa Barbara, Parry, 1876; Orcutt), as far north as Vancouver Island.

General. Great Britain to Holland southward; Asia, Africa and Australia.

2. BECKMANNIA.

Beckmannia Host Gram. Austr. 3: 5. *pl.* 6. 1805. Bentham & Hooker. Gen. Pl. 3: 1099 Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 60. Endlicher Gen. Pl. 80. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20. 107. *f.* 81. (Rev. ed.)

Bruckmannia Nutt. Gen. 1: 48. 1818.

Joachimea Ten. ex. Kunth. Enum. 1. 1833.

Spikelets jointed upon the pedicels, 1 to 2-flowered (only one fertile), obovate and laterally compressed, imbricated in two rows upon one side of the angled rachis of a spike. Glumes 3 or 4, the 2 lower strongly concave and connate, obtuse or acutish, the 1 or 2 flowering glumes narrower, lanceolate, acute or acuminate, and a little exserted, becoming rather rigid, and with the thin palet enclosing the oblong grain. A stout, erect, subaquatic perennial, with the short spikes erect and simply spicate, or in a strict, narrow panicle. (Named for John Beckman, professor of botany at Goettingen.)

One species. Southern and eastern Europe, temperate Asia and North America.

1. BECKMANNIA ERUCAEFORMIS.

Beckmannia eruciformis Host. Gram. Austr. 3: 5. 1805.

Beckmannia eruciformis Host. var. *uniflora*. Scribner. Watson and Coulter. Gray. Man. Bot. 628. 1900. *pl.* 15. (6 ed.)

Beckmannia eruciformis uniflorus Scribner. Beal. Grasses of N. A. 2: 428. *f.* 77. 1896.

Beckmannia eruciformis (L.) Host. Nash in Britton and Brown. Ill. Fl. 1: 181. *f.* 414. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 214. *f.* 208. 1900. (3 ed.)

Bruckmannia eruciformis Nutt. Gen. 1: 48. 1818.

Phalaris eruciformis L. Sp. Pl. 55. 1753.

DESCRIPTION.

SLOUGH GRASS OR WILD TIMOTHY. A stout, erect, subaquatic perennial, 1 to 4 feet (3-12 dm.) high, with narrow panicles composed of many, densely-flowered, one-sided spikes. Sheaths longer than the internodes, loose; ligule 2 to 4 lines (4-8 mm.) long; leaf blades 3 to 9 inches (7-22 cm.) long, 2 to 4 lines (4-8 mm.) wide, scabrous. Spikelets 1 to $1\frac{1}{2}$ lines long, one to two-flowered, imbricated in two rows on one side of the rachis; empty glumes smooth, saccate, obtuse or abruptly acute; flowering glumes acute, the lower generally awn-pointed. In sloughs and along the banks of streams. June to September. A valuable grass. Found in Iowa, however, only in the north-western section of the state.



FIG. 140. *Beckmannia erucaeformis*—a, and b, spikes; c, spikelet; d, flowering glume. (Div. Agros. U. S. Dept. Agri.)

DISTRIBUTION.

Iowa. Ames, cult. (Sirriner); Spencer (Hitchcock); Little Rock (Ball); Lyon County (Shimek); Sheldahl (Hitchcock).

North America. Minnesota, Iowa, Nebraska, Dakota (Douglas), Wyoming (Blacks Fork, Fuller's Ranch, Pammel), Montana (Craig), Colorado (Ft. Collins, Pammel, Crandall); Nevada (Reno, Tracy), to California, Oregon, Washington, British Columbia, Manitoba as far north as Lake Misstassini.

General. Southern Europe to the Orient; Siberia.

3. SPARTINA.

Spartina Schreb. Gen. Pl. 43. 1789. Steud. Syn. Pl. Glum. 214. Endlicher. Gen. Pl. 94. Bentham & Hooker Gen. Pl. 3: 1108. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 58. Beauv. Agros. 25. pl. 7. f. 6. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 100. f. 74. (Rev. ed.)

Trachynotia Michx. Fl. Bor. Am. 1: 63. 1803.

Ponceletia Thou. Fl. Trist. d'achun. 36. 1896.

Solenachne Steud. Pl. Glum. 1: 12.

Spikelets 1-flowered, very much flattened laterally, jointed and sessile, in two ranks on the outer side of a triangular rachis. Glumes 3, unequal, lanceolate, strongly compressed-keeled, acute or bristle-pointed, mostly rough-bristly on the keel; palet thin, equalling or longer than the flowering glume. Stamens 3. Styles long, more or less united. Perennials, with simple and rigid, often reed-like culms, from extensively creeping, scaly rootstocks, racemed spikes, very smooth sheaths and long, tough leaves (whence the name from the Greek word for a cord, such as was made from the bark of the *Spartium* or Broom.)

Bentham & Hooker give the number of species as 5 or 6; Hackel lists 7; found mostly in temperate and tropical regions, especially saline. Three of the species are native to the Atlantic coast regions of North America. Two species found in the interior of our country, especially in brackish and saline soils; one species upon the Islands of Tristan, de Cunha, Amsterdam and St. Paul.

1. SPARTINA CYNOSUROIDES.

Spartina cynosuroides Willd. Enum. 80. 1809. Watson and Coulter. Gray. Man. Bot. 627. 1890. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 87. f. 116. 1894.

Spartina cynosuroides (L.) Willd. Beal. Grasses of N. A. 2: 397. f. 70. 1896. Nash in Britton and Brown. Ill. Fl. 1: 175. f. 401. 1896. Scribaer. Bull. U. S. Dept. Agrl. Div. Agros. 7: 179. f. 173. 1900. (3 ed.)

Dactylis cynosuroides L. Sp. Pl. 71. 1753.

DESCRIPTION.

FRESH WATER CORD
GRASS OR SLOUGH GRASS.

A stout, erect grass, 2 to 6 feet (5-8 dm.) high, with unbranched, smooth culms from strong, creeping, scaly root-stocks. Leaf-blade 1 to 4 or 6 feet (2-8 or 12 dm.) long, 2 to 4 lines (4-8 mm.) wide, rough on the margins, gradually tapering into long, filiform tips. Spikes 5 to 20, spreading, racemose along the main axis. Empty glumes unequal, aculeolate-scabrous along the rigid keels, acute or the second long-acuminate or short awn-pointed. Flowering glume serrulate-scabrous along the keel or midrib, which abruptly terminates just below the membranous apex. River banks and lake shores. July to October.



FIG. 141. *Spartina cynosuroides*—a, and b, spikelets; c, flowering glumes. (Div. Agros. U. S. Dept. Agrl.)

Slough grass is widely distributed in the state. It is, however, most abundant in alluvial river bottoms, as the Missouri and Mississippi, where it does much to bind the soil. It is used to some extent for hay.

DISTRIBUTION.

Iowa. 7 Forest City, Spirit Lake, Rock Rapids (Shimek); Decatur County, Appanoose County (Fitzpatrick); Muscatine County (Bartsch); Jones County (Macbride); Fayette (Fink); 729 Dixon (Snyder); 506 Muscatine (Reppert); Humboldt (Wells); 643 Mt. Ayr (Beard); 1001 Chariton (Mallory); 1015 Carroll (Simon); 814 Dallas County (Rhinehart); 702 Amana (Schadt); 806 Creston (Bettenga); Mt. Pleasant (Witte, Mills); 1437 West Union (Whitmore); Belknap (Rankin); Boone (Steele); Colfax (Mead); 884

Slater, Turin, 778 New Albin, Boone, Carroll, Dakota City, Ledyard, Hawarden, Turin (Pammel); Ames (C. A. Wilson, Reynolds, Crozier, Beardslee, Kaufman, Hitchcock, Bessey, Rich and Gossard, Pammel, Serrine); 1051 Armstrong (Cratty); Sioux City (Miss Wakefield); Iowa City (Hitchcock); 1156 Alden (Stevens); Des Moines (Carver); Newton (Misses Cavanagh and Dilne); High Bridge, Dallas County (Shimek); Iowa City (Macbride); Hamilton to Hancock County (Preston); Johnson County (Armstrong, Shimek, Parry); Nevada (Pammel); Slater (Fawcett and Tener); Sioux City (Shimek).

North America. From Nova Scotia through New England; Massachusetts (Sears), to New York (Washington County, Parry); south to New Jersey, Ohio (Columbus, Sullivant); Tennessee, Alabama, Missouri (St. Louis, Eggert), Nebraska (McCook, Pammel), Iowa, Minnesota (Centre City, Sandberg, 671), South Dakota (Watertown, Holsinger), Wisconsin (La Crosse, Pammel), Illinois (Evanston, Pammel).

4. SCHEDONNARDUS.

Schedonnardus Steud. Flora. 33: 228, 229. 1850. Syn. Pl. Glum. 1: 146. 1855. Bentham & Hooker Gen. Pl. 3: 1167. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 59. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 105. f. 79.

Lepturus sec. *Schedonnardus* in part. Endlicher. Gen. Pl. 104.

Spikelets small, acuminate, 1-flowered, appressed-sessile and scattered along one side of the slender rachis of the distant, sessile and divaricately spreading spikes. Empty glumes persistent, narrow, acuminate, more or less unequal, the longer usually a little shorter than the rather rigid, acuminate, flowering one. Stamens 3. Styles distinct. Grain linear. A low, slender annual, branching from the base, with short, narrow leaves. (Name the Greek word for *near*, and *Nardus*, from its resemblance to that genus.)

Monotypic genus. In North America from the Plains region to the Pacific coast, most abundant on the plains.

1. SCHEDONNARDUS PANICULATUS.

Schedonnardus paniculatus Trelease in Branner & Coville. Rept. Geol. Surv. Ark. 1888: 236. 1891.

Schedonnardus paniculatus (Nutt.) Trelease Beal. Grasses N. Am. 2: 412. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 199. f. 193.

Lepturus paniculatus Nutt.
Gen. 1: 81. 1818.

Schedonnardus Texanus Steud.
Syn. Pl. Gram. 146. 1854. Watson
and Coulter Gray. Man. Bot. 655.
1890.

Rottboellia paniculata Spreng.
Syst. 1: 1825.

DESCRIPTION.

TEXAN CRAB GRASS. A low, diffusely branching annual, with short, narrow leaves and numerous slender, paniculate spikes, 1-4 inches (2-10 cm.) long, and tufted stems from $\frac{1}{4}$ to 3 feet (1 to 9 dm) high. Sheaths loose, compressed; ligule acute, lacerate, decurrent; leaf-blades plain or folded, spirally twisted, smooth, 2-3 inches (5 to 8 cm.) long. Spikelets sessile and appressed, $1\frac{1}{2}$ to 2 inches (3 to 4 mm.) long, alternate; empty glumes lanceolate, 1-nerved; flowering glume 3-nerved, scabrous on the keel, slightly pubescent at the base. Palea ovate, 2-nerved, 2.5-3 mm. long.

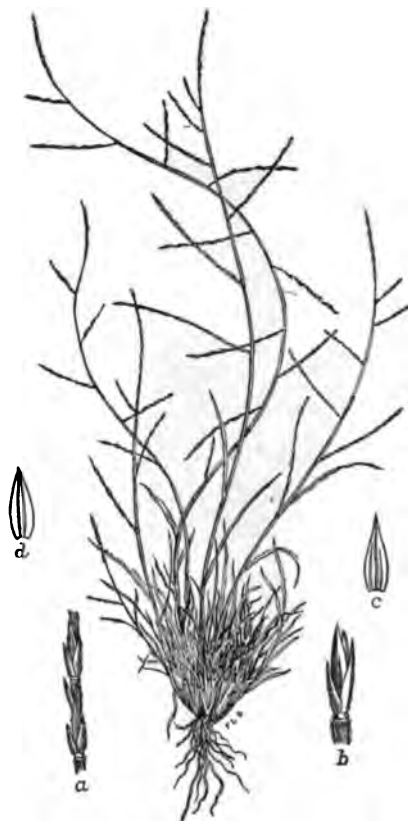


FIG. 142. *Schedonnardus paniculatus*—a, spike; b, spikelet; c, flowering glume; d, palea. (Div. Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. N. W. Iowa, Lyon County (Shimek).

North America. From western Minnesota, northwestern Iowa; through Nebraska (Hastings; Broken Bow, 14; Alma, 15, North Platte; Kearney; McCook, 236, 380; Crete, 214; Oxford, 263 Pammel), Kansas, western Arkansas; South Dakota (Pierre, Griffith); to Texas (Thurrow), New Mexico (Chaves, Tracy; Parry, 235), Colorado (Ft. Collins, E. D. Ball; Greeley, Larimer County, Pammel; Ft. Collins, Cowen), Wyoming (Headwaters Missouri and Yellowstone Rivers, Hayden), Montana, Alberta and Manitoba.

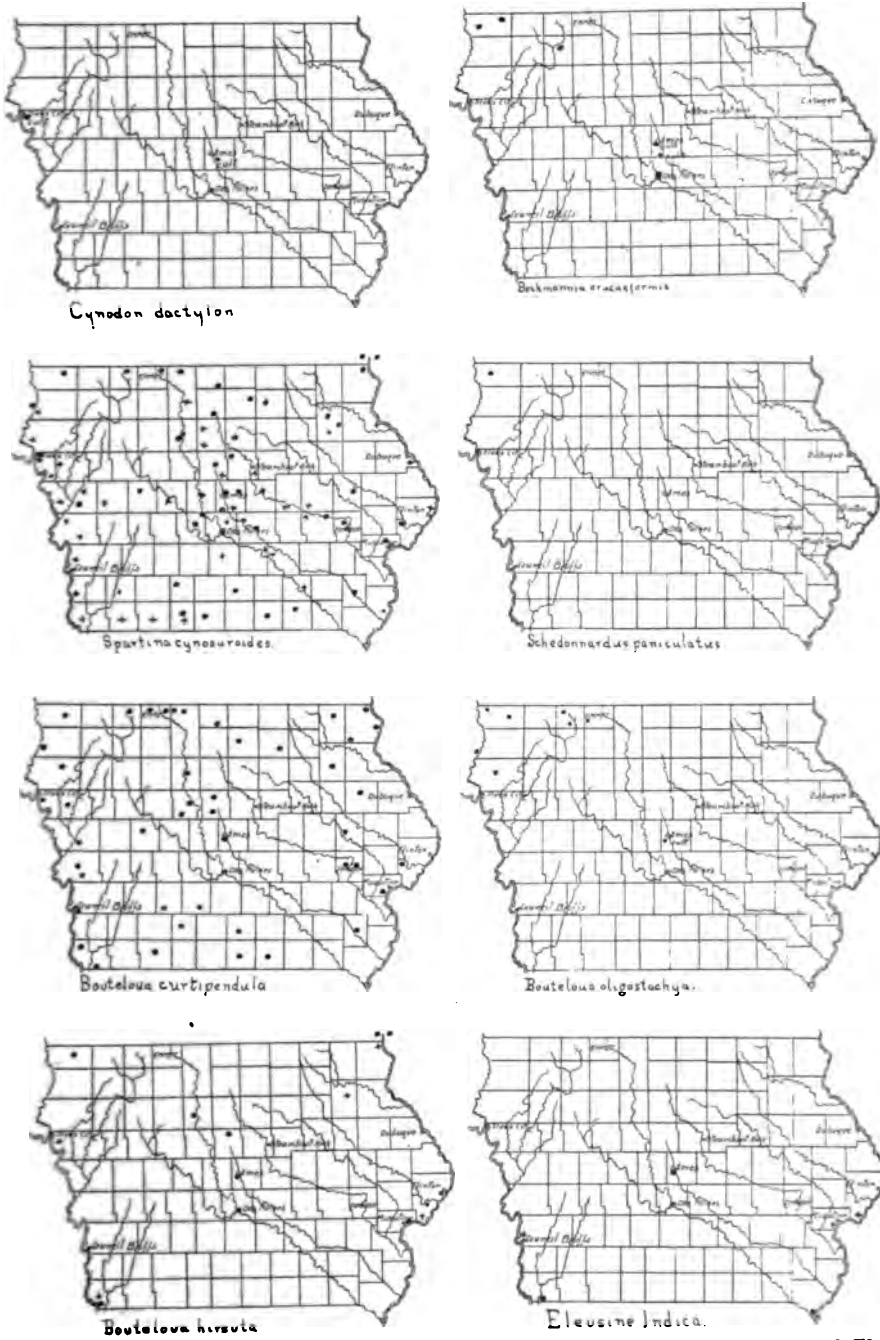


FIG. 142. Distribution of *Cynodon*, *Beckmannia*, *Spartina*, *Schedonnardus*, *Bouteloua* and *Eleusine*.
 ● Specimens in herbarium. + Localities observed.

5. BOUTELOUA.

Bouteloua Lag. Var. Cienc. y. Litt. 2: 141. 1805. Benth. & Hooker. Gen. Pl. 3: 1168. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 106. f. 80. (Rev. ed.)

Chondrosium Endlicher. Gen. Pl. 94.

Chondrosium Desvz Bull. Philom. 2: 188. 1813. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 59. f. 70.

Spikelets crowded and closely sessile, in 2 rows on one side of a flattened rachis, comprising one perfect flower below, and one or more sterile (mostly neutral) or rudimentary flowers. Glumes convex-keeled, the lower one shorter. Perfect flower with the 3-nerved glume 3-toothed or cleft at the apex, the 2-nerved palea 2-toothed, the teeth, at least of the former, pointed or subulate-awned. Stamens 3; anthers orange colored or red. Rudimentary flowers mostly 1 to 3-awned. Spikelets solitary, racemed or spiked; the rachis somewhat extended beyond the spikelets. (Named for Claudius Bouteloua, a Spanish writer upon floriculture and agriculture.)

About 25 species, chiefly American. Largely developed west of the Missouri river, in southwestern United States. A few species of wider distribution. Benth. & Hooker recognize 25 species; Hackel in Engler and Prantl, 30; Scribner, 30; Heller catalogues 18 species for the United States. There are 3 in Wisconsin, Minnesota Valley 3, Iowa 3, Alabama 1, Tennessee 1, New York 1, New Jersey 1, Rocky Mountains 5, California 3 to 4, western Texas 17, Mexico and Arizona 23, Canada 3.

KEY TO THE SPECIES OF BOUTELOUA.

Spikes of few spikelets, short, numerous, in a long, one sided raceme (*Atheropogon*).....*B. curtipendula*.¹

Spikes pectinate, of many spikelets, solitary, or a few in a raceme. —*Chondrosium*.

Pedicle of rudimentary flower with a tuft of long hairs at summit. —*B. oligostachya*.²

Pedicle of rudimentary flower glabrous.....*B. hirsuta*.³

1. *BOUTELOUA CURTIPENDULA*.

Bouteloua curtipendula Torr. in Emory, Notes. Mil. Recon. 153. 1848.

Bouteloua curtipendula (Michx.) Torr. Nash in Britton and Brown. Ill. Fl. 1: 180. f. 413. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 201. f. 195. 1900. (3 ed.)

Bouteloua racemosa Lag. Watson and Coulter. Gray. Man. Bot. 656. pl. 9. 1890. (6 ed.)

Atheropogon aptudioides Muhl. Willd. Sp. 4: 927. 1805.

Cynosurus secundus Pursh. Fl. Bor. Am. 728. 1814.

Chloris curtipendula Michx. Fl. Bor. Am. 1: 59. 1803.

DESCRIPTION.

TALL GRAMA OATS. A densely tufted perennial, 1 to 3 feet (3-9 dm.) high, with numerous (twenty to sixty), usually spreading or reflexed spikes scattered along the common axis, forming a long, somewhat one-sided raceme, 8 to 16 inches (20-40 cm.) long. Sheaths loose, sparsely pubescent; leaf-blades 4 to 12 inches (10-36 cm.) long, 2 lines (4 mm.) wide, scabrous. Spikes 3 to 8 lines (6-16 mm.) long, reflexed. Spikelets $3\frac{1}{2}$ to 5 lines (7-10 mm.) long; empty glumes unequal, the first awn-pointed, the second acute; flowering glumes about 2 lines (4 mm.) long, with three short awns. Tall Grama Oats is widely distributed in Iowa, occasionally abundant, as on the loess bluffs of western Iowa along



FIG. 144. *Bouteloua curtipendula*—a, spike; b, spikelet; c, flowering glume. (Div. Agros. U. S. Dept. Agr.)

the Missouri and its tributaries. In northern Iowa it is found on moraines and gravelly knolls. An excellent forage grass.

DISTRIBUTION.

Iowa. Charles City (Pammel); Council Bluffs (Pammel); Ames (Zimunt 3196, Hunt and Rolfs, Charles Wilson 154, Ball, Crozier, Sirrine, Pammel, Fairfield, Fisher, Rich and Gossard, Hitchcock, Beardslee); Carroll, Missouri Valley, Logan 897, New Albin, Turin 256, Dakota City, Cedar Rapids 787 and 1102, Marshalltown 654, Des Moines, Council Bluffs, South Dakota opposite Hawarden, Sioux City (Pammel); Mason City, 3131 (Miss King and Brown); Lansing, 3150 (Miss King); Taylor County, 1017 (Pool); Forest City (Shimek); Webster City (Taylor); Mt. Pleasant, 1469 (Mills); Peru, 869 (Hollingsworth); Creston, 803 (Bettenga); Chariton, 765 (Mallory); Ft. Dodge, 2237 (Pammel and Sokol); Manchester, 1008 (Ball); Ledyard, 756 (Pammel and Cratty); Armstrong (Cratty); Harcourt (Danielson); Hull (Newell); Forest City, 710 (Peters); Jewell Junction (Carver); Bartlett, 873 (Baldwin); Dixon, 727 (Snyder); Muscatine (Reppert); Fayette (Fink); Johnson County (Fitzpatrick); Greenfield (Stewart); Appanoose County (Fitzpatrick); Decatur County (Fitzpatrick); Sioux City (Miss Wakefield); Emmet County, 1021 (Pammel and Cratty); Myron (Miss King); Okoboji, Mason City (Shimek); Winneshiek County (Goddard); Hamburg, Rock Rapids, Iowa City (Preston); Johnson County (Miss Linder); Plymouth County (Brown); Sioux City (Shimek); Mason City (Pammel).

North America. Ontario to Manitoba, New York, to New Jersey, Tennessee, Alabama, Texas (Collins County, Pammel); west to Kansas, Nebraska (North Platte and Kearney, Pammel), Dakotas (S. D., Brookings, Gunn); Wisconsin (La Crosse, Miss King), Ohio (Horr), Missouri (Jefferson, Eggert), Illinois (French Village, Eggert), Colorado (Ft. Collins, Crandall), New Mexico (Vasey), Arizona (Nealley).

2. *BOUTELOUA OLIGOSTACHYA.*

Bouteloua oligostachya Torr. Gray. Man. Bot. 553. 1856. (2 ed.) Watson and Coulter. Gray. Man. Bot. 656. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl Exp. Sta. 7: 89. f. 118. 1894.

Bouteloua oligostachya (Nutt.) Torr. Beal. Grasses of N. A. 2: 417. 1896. Nash in Britton and Brown. Ill. Fl. 1: 180. f. 412. 1896. Scribner. Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 7: 210. f. 204. 1900. (3 ed.).

Chondrosium oligostachyum Torr. Marcy Report. 300. 1853.

Atheropogon oligostachya Nutt. Gen. 1: 78. 1818.



FIG. 145. *Bouteloua oligostachya*—a, empty glumes; b, flowering glumes. (Div. Agros. U. S. Dept. Agrl.)



FIG. 144. *Bouteloua hirsuta*—1, empty glumes; 2, flowering glumes. (Div. Agros. U. S. Dept. Agrl.)

DESCRIPTION.

MESQUITE GRASS. A slender perennial, 6 to 20 inches (12-40 cm.) high; with one to five, remote, pectinately many-flowered, usually spreading spikes, 1 to 2 inches (2-5 cm.) long. Spikelets about 3 lines (6 mm.) long; flowering glumes hairy on the back; palea as long as its glume, with tufted, long hairs on each side, at the base; pedicel of the rudimentary floret hairy at the tip, and bearing several rudimentary glumes and three very short awns. June to October.

Mesquite grass is not common in the state. It occurs from Dickinson County west to S. Dak., as far south as Hawarden in Sioux Co.; through Sioux, Lyon and Dickinson counties, and extends into Minnesota north and eastward to Wisconsin. It is an excellent forage plant, one of the best for the states west of the Missouri and east of the Rocky Mountains.

DISTRIBUTION.

Iowa. Estherville, 1060 (Cratty); Plymouth County, Leiberg, Lake Okoboji (Hitchcock); Ames (cult., Hodson); South Dakota, opposite Hawarden (Pammel); Estherville (Shimek); Rock Rapids and Lyon County, northwest corner state (Shimek); Millford (Shimek).

North America. Prairies of southwestern Minnesota, northwestern Iowa, south to Arkansas (Ft. Smith, Rolfs); Texas (Nealley), New Mexico (Vasey); through Kansas, Nebraska (Hastings, Pammel; McCook, 241, 381; Broken Bow, North Platte, Crete, 210; Oxford, 239; Alma, Pammel; Grand Island, Wakefield; Sioux County, Miller), Colorado (Ft. Collins, Crandall; Golden, eastern Colorado, Pammel), Wyoming (New Castle, Pammel), and west to southern California and Mexico (Parry and Palmer 944).

3. BOUTELOUA HIRSUTA.

Boutelona hirsuta Lag. var. Cienc. y. Lit. Art. 2: 141. 1805. Beal. Am. Grasses. 2: 417. 1896. Watson and Coulter. Gray. Man. Bot. 656. 1890. (6 ed.) Nash in Britton and Brown. Ill. Fl. 1: 180. f. 411. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 211. f. 205. 1900. (3 ed.)

Chondrosium foenum Torr. Marcy. Rept. 157. 1848.

DESCRIPTION.

HAIRY MESQUITE GRASS. A caespitose perennial, 6 to 16 inches (1½-4 dm.) high, with erect or ascending culms, flat leaves, and one to three, more or less spreading, densely flowered spikes, 1 to 2 inches (2-4 cm.) long. Leaves usually short, 1 to 4 inches (2-10 cm.) long. Spikelets numerous, 2½ to 3 lines (5-6 mm.) long; empty glumes unequal, the first one smooth, 1 line (2 mm.) long, the second about 2½ lines (5 mm.) long, with a row of dark or black glands on either side of the mid-nerve, each one emitting a long hair; flowering glume nearly smooth, three-lobed, each lobe terminating in a short awn; rudiment on a short pedicel, consisting of three awns and three imperfect glumes. July to September. Dry prairies and sandy plains. Hairy mesquite grass is abundant in some places on Muscatine Island, and in sandy soils along the Missouri. In central and northern Iowa it occurs on gravelly knolls and moraines. It is an excellent grass, but it is not productive. (See fig. 146, page 207.)

DISTRIBUTION.

Iowa. Ames (Beardslee, Hitchcock, Bessey, Anderson, 116 Ball); Clinton, Webster City (Pammel); Muscatine (Reppert and Pammel); Lyon County, Hamburg (Shimek).

North America. Dry soil, and prairies of Illinois, Wisconsin (Vasey; La Crosse, Pammel, Charlotte King and Dora Pammel), Minnesota (Sandberg), Iowa, Texas, Colorado (Ft. Collins, Cowen), Wyoming; Mexico (Palmer, 1886).

6. ELEUSINE.

Eleusine Gaertn. Fruct. 1: 7. *pl.* 1. 1788. Endlicher. Gen. Pl. 93. Bentham & Hooker. Gen. Pl. 3: 1172. Hackel in Engler and Prantl. Nat. Pflanz Fam. II. 2: 61. *f.* 71. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 108. *f.* 82. (Rev. ed.)

Cynosurus Schreb. Besch. Gras. Pl. 35. Beauv. Agros. 72. *f.* 3.

Dactyloctenium Kunth. Enum. Pl. 1: 261.

Spikelets 2 to 6-flowered, with a terminal, imperfect flower or naked rudiment, closely imbricate-spiked on one side of a flattish rachis; the spikes digitate. Glumes membranaceous, shorter than the flowers; flowering glume and palea awnless, the glume ovate, keeled, larger than the palea. Stamens 3. Pericarp (utricle) containing a loose, wrinkled seed. Low annuals, with flat leaves, and flowers much as in *Poa*. (Named from a Greek town where Ceres, the goddess of harvests, was worshipped.)

Species about 7. Found chiefly in tropical and sub-tropical regions of the Old World; one species is a weed in warmer temperate regions of the world.

1. ELEUSINE INDICA.

Eleusine Indica Gaertn. Fruct. and Sem. 1: 8. 1788. Watson and Coulter. Gray. Man. Bot. 656. *pl.* 9. *f.* 1-6. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 90. *f.* 120. 1894. Beal. Grasses of N. A. 2: 430. *f.* 78. 1896. Nash in Britton and Brown. Ill. Fl. 1: 181. *f.* 415. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 215. *f.* 209. 1900. (3 ed.)

DESCRIPTION.

WIRE GRASS. A coarse, tufted annual, with erect or spreading stems, 6 to 24 inches (15-55 cm.) high, and digitate spikes. Sheaths compressed and sparingly ciliate; leaf-blade long and narrow, both surfaces glabrous, or the upper scabrous and thinly hairy. Spikes five to seven, 2 to 4 inches (5-10 cm.) long, digitate at the apex of the culm, often with one or two lower down, widely spreading; spikelets closely imbricated, $1\frac{1}{2}$ to 2 lines ($3\frac{3}{4}$ -5 mm.) long, three to six-flowered; glumes obtuse, the first small and one-nerved, the second larger and with the flowering glumes, three to five-nerved. Seeds rugose, enclosed within a thin, loose pericarp. Blooming from June to October. Waste or cultivated ground. *Eleusine Indica* is naturalized in southern Iowa from Davenport and Muscatine to Council Bluffs.



FIG. 147. *Eleusine indica*—a, spike; b, spikelet; c, flowering glume; d, seed. (Div. Agros. U. S. Dept. Agrl.)



FIG. 148. *Buchloe dactyloides*—a, pistillate plant; a', pistillate spikelet; b, staminate plant; b' staminate spikelet; c, spikelet. (Div. Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. Keokuk (P. H. Rolfs); Ames (Pammel, Kaufman, Sirrine), Muscatine (Reppert), Hamburg, Keokuk (Hitchcock), Davenport (Pammel).

North America. Massachusetts to New York (Parry), New Jersey (Highland Park, Halsted), Ohio (Worthington, Horr; Painsville, Beardslee), Virginia (Morgantown, Millspaugh, 660), District of Columbia (Washington, Pammel), south to Florida (Duval County, Curtiss, 3448); west to Texas, southern Iowa, Kansas, Missouri (St. Louis, Eggert; Cairo, McKinney; St. Louis and Jefferson Barracks, Pammel), Mexico (Guadalajara, Palmer, 242, 255; Rio Blanca Palmer), and Central America. Cuba (Santa Clara Province, Combs, 260.)

General. Western Asia, East Indies, South Africa, Australia, West Indies, south to Brazil.

7. BUCHLÆ.

Buchlæ Engelm. Trans. St. Louis Acad. 1: 432. *pl.* 14. 1859.
Bentham & Hooker. Gen. Pl. 3: 1173. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 61.

Melica. Endlicher Gen. Pl. 100.

Bulbilis Raf. Am. Mo. Mag. 4: 190. 1819. Scribner Bull. U. S. Dept. Agr. Div. Agros. 20: 14. *f.* 85. [Rev. Ed.]

Sesleria Nutt. Gen. 1: 64. 1818.

Calanthera Nutt. not Kunth. Mss. Kew. Jour. 8: 18.

Spikelets dioecious (rarely monoecious), very unlike; the staminate 2 to 3-flowered, sessile, in 2 rows in short one-sided spikes, the empty glumes blunt, 1-nerved, very unequal, the flowering larger, 3-nerved, a little exceeding the 2-nerved palet; fertile spikelets 1-flowered, in a contracted, capitate, 1-sided spike, the large outer glumes indurated, trifid at the apex, united at base and resembling an involucre, the inner (lower) much smaller and membranaceous, or in the lowest spikelet resembling the outer; flowering glume narrow, hyaline, bifid or nearly entire, enclosing the 2-nerved palet. Styles distinct. Grain ovate, free. A perennial, creeping or stoloniferous plant, with narrow, flat leaves; staminate spikes (2 to 3) in a pedunculate spike, the pistillate pair sessile in the broad sheaths of the upper leaves. (Name a contraction of *Bubalo* and *grass*.)

One living species; monotypic genus of North America.

1. BUCHLÆ DACTYLOIDES.

Buchlæ dactyloides Engelm. Trans. St. Louis Acad. 1: 432. 1859.
Watson and Coulter. Gray. Man. Bot. 657. *pl.* 15. 1890. (6 ed.)

Bulbilis dactyloides (Nutt.) Rafin. Beal. Grasses of N. A. 2: 439. *f.* 80. 1896. Nash in Britton and Brown. Ill. Fl. 1: 183. *f.* 418. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 226. *f.* 220. 1900. (3 ed.)

DESCRIPTION.

BUFFALO GRASS. A low, fine leafed and extensively creeping perennial, rarely more than 4 to 6 inches (1-1.5 dm.) high; staminate-spikes 2 or 3, approximate; the empty glumes 3-nerved; pistillate spikelets ovoid, the outer glume indurated. Similar to Bermuda grass in habit of growth. Dry prairies and river bottoms. Ascends 4950 feet in the Black Hills. July to August. See figure 148 on page 210.

Buffalo grass is local, only occurring in Lyon County on the Sioux quartzite, associated with *Schedonnardus*, where it was found by Professor Shimek and Mr. Leiberg.

DISTRIBUTION.

Iowa. Northwest corner of state (Shimek).

North America. Saskatchewan to Minnesota; Iowa, Dakotas (S. D., Aberdeen, Griffiths, 122); Nebraska (Crete, McCook and Broken Bow, Pammel; Belmont, Webber, 160; Grand Island, Wakefield, 114); Kansas, Arkansas, Texas (Nealley); Mexico (San Luis Potosi, Parry and Palmer, 922); and Arizona north to Colorado (Hall and Harbour, 637; Platte River, Parry, 368; New Windsor, Osterhout, 2373; Ft. Collins, Reppert and Witter; Crandall; E. D. Ball; Pammel).

TRIBE XI. FESTUCEAE.

Spikelets 2 to many-flowered, usually hermaphrodite, pedicellate, in racemes or panicles, the latter sometimes dense and spike-like; flowering glumes usually longer than the empty ones, awnless or with one to several, straight (rarely bent) awns which are either terminal or borne just below the apex.

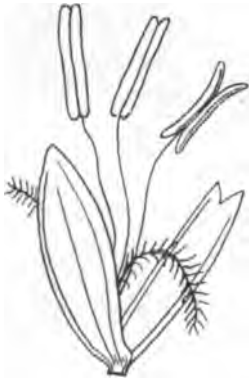


FIG. 149. Flower of *Poa compressa*. (after Gray.)



FIG. 150. Flower of *Festuca elatior*. (after Gray.)

This is the largest tribe in the order, numbering about 76 genera and 725 species. It contains the most important meadow grasses. Also occur on the higher mountains within the tropics. The genus *Poa*, which includes Kentucky blue grass, Texas blue grass, etc., numbers 100 species, and an equal number of species are included in the genus *Eragrostis*.

The Fescues number 80 species, and the tribe takes its name from the genus, *Festuca*. Orchard grass, *Dactylis glomerata*, is another well-known example of this tribe.

KEY TO THE GENERA OF THE FESTUCEAE.

Plants dioecious.

Flowering glume 3-nerved, subulate, finely awned. Tall, reed-like grass
—*Gynerium*. ¹.

Flowering glume 5-nerved, broad. Low meadow grass
—*Poa arachnifera*. ¹³.

Plants not dioecious.

Rachilla clothed with hairs, exceeding the glumes in length. Tall, aquatic reed.....*Phragmites*. ².

Rachilla naked or its hairs much shorter than the flowering glumes.

Flowering glumes 1-3-nerved or rarely with faint, additional, intermediate nerves.

Flowering glumes membranaceous, seed not beaked or exserted.

Callus and lateral nerves of the flowering glumes hairy.

Flowering glume tridentate or with the prolonged nerves mucronate between the teeth.....*Triodia*. ³.

Flowering glume deeply 3-cleft, the lateral divisions very narrow, the central produced into a fine awn.*Triplasis*. ⁴.

Callus and lateral nerves of the flowering glume glabrous.

Empty glumes of the same shape.

Panicle spike-like, shining.....*Koeleria*. ⁵.

Panicle more or less open and spreading...*Eragrostis*. ⁶.

Empty glumes of different shape, the second broad and rounded at the apex.....*Eatonia*. ⁷.

Flowering glume coriaceous in fruit, seed beaked and exserted

—*Diarrhena*. ⁸.

Flowering glumes 5-many-nerved.

Spikelets with two or more of the upper glumes empty, broad and enfolding each other.....*Melica*. ⁹.

Spikelets with the upper glumes fertile, or narrow and abortive.

Glumes more or less strongly compressed and keeled, awnless or only awn-pointed.

Spikelets broad, flat, in loose panicles, the 3-6 lower glumes empty, cultivated.....*Uniola*. ¹⁰.

Spikelets in one-sided clusters, flowering glumes herbaceous, awn-pointed, rough ciliate on the keel

—*Dactylis*. ¹¹.

Spikelets heart-shaped, in loose panicles, glumes roundish, ventricose, scarious margined. Cultivated.

—*Briza*. ¹².

Spikelets lanceolate or ovate lanceolate, small, in a rather loose panicle; flowering glumes scarious margined, mostly webbed at the base.....*Poa*. ¹³.

Glumes rounded on the back, not keeled (or only in some species of *Bromus*), awned in most of *Festuca* and *Bromus*.

The rachis bearing a ring of hairs at the base of the flowering glume, which is toothed at the apex; a water grass.....*Scolochloa*. ¹⁴.

No ring of hairs at base of the flowering glumes.

Flowering glumes prominently 5-7 nerved, scarious at the usually obtuse apex.....*Glyceria* ¹⁵.

Flowering glumes acute, few-nerved, awned or awn-pointed at the apex; styles terminal..*Festuca*. ¹⁶.

Flowering glumes 5-9-nerved, acute, mostly awned from below the 2-toothed apex, sometimes keeled on the back, at least above; style scarcely terminal.

—*Bromus*. ¹⁷.

1. GYNERIUM.

Gynerium. H. B. K. Plant. Aequin. 2: 112. *pl.* 115. 1809. Endlicher. Gen. Pl. 91. Bentham & Hooker. Gen. Pl. 3: 1178. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 67. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 124. *f.* 93. [Rev. Ed.]

Spikelets loosely 2 to many-flowered; dioecious; rachilla articulated above the empty glumes, usually long-pilose, at least in the fertile spikelets. Empty glumes 2, narrow and very long, acuminate-pointed; flowering glumes very narrow, produced into long, subulate points, the back and margins clothed with long, silky hairs; flowering glumes in the staminate spikelets usually smooth. Tall, reed-like, perennial grasses, with solid culms, and very long, narrow leaves, which are chiefly from the base, and ample, showy, terminal panicles.

A small genus of South American plants of 3 species. Occasionally cultivated, but not hardy; extensively cultivated, however, in California under the name of Pampas grass.

1. GYNERIUM ARGENTEUM,

Gynerium argenteum. Nees. Agr. Bras. 462. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 124. *f.* 93. 1900. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 92. 1890.

DESCRIPTION.

PAMPAS GRASS. Culm six to ten feet high, with numerous, very long, narrow leaves, and silvery-white panicles, one to two and one-half feet long. This grass is highly decorative for lawns, and the large, plume-like panicles are used for dry bouquets. In California it is cultivated for these "plumes" which command a ready market in the larger cities. The grass is a native of Brazil and Argentine Republic, where

the long, tough leaves are employed in the manufacture of paper, and a decoction of the stout rhizomes is valued as a diuretic.



FIG. 151. *Glycerium argenteum*—a, empty glumes of a pistillate spikelet; b, pistillate spikelet, the empty glumes removed; c, empty glumes of a staminate spikelet, empty glumes removed. (Div. Agros. U. S. Dept. Agrl.)

2. PHRAGMITES.

Phragmites. Trin. Fund. Agrost. 134. 1820. (in part.) Endlicher Gen. Pl. 91. Bentham & Hooker Gen. Pl. 3: 1179. Hackel in Engler & Prantl. Nat Pflanz. Fam. II. 2: 68. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 126. f. 95. [Rev. Ed.]

Arundo Beauv. Agrost. 60. pl. 13. f. 2. 1812.

Czernya Presl. Cyp. & Gram. 22: 1820.

Spikelets 3 to 7-flowered; the flowers rather distant, silky villous at base, and with a conspicuous, silky-bearded rachis, all perfect and 3-

androus, except the lowest, which is either neutral or with 1 to 3 stamens, and naked. Glumes membranaceous, shorter than the flowers, lanceolate, keeled, sharp pointed, very unequal; flowering glume and palet membranaceous, slender, the glume narrowly awl-shaped, thrice the length of the palet. Squamulae 2, large. Styles long. Grain free. Tall and stout perennials, with long, running rootstocks, numerous broad leaves, and a large terminal panicle. (From a Greek word meaning *growing in hedges*, which this aquatic grass does not.)

Two or three species; one, *Phragmites communis*, is cosmopolitan; one is native to tropical Asia, one to Argentine Republic and one to North America.

1. PHRAGMITES COMMUNIS.

Phragmites communis Trin. Fund. Agrost. 134. 1820. Watson and Coulter. Gray, Man. Bot. 658. *pl. II*. 1890. (6 ed.) Scribner. Grasses of Tenn. Univ. Tenn. Agr. Exp. Sta. 7: 93. 1894.

Phragmites Phragmites (L) Karst. Beal. Grasses of N. A. 2: 460. *f. 92*. 1896. Nash in Britton and Brown. Ill. Fl. 1: 184. *f. 420*. 1896.

Phragmites vulgaris (Lam.) B. S. P. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 235. *f. 229*. 1900. (3 ed.)

Arundo Phragmites L. Sp. Pl. 81. 1753.

Arundo vulgaris Lam. Fl. Fr. 3: 615. 1778.

Czernia arundinacea Pr. Gram. 22. 1820.

DESCRIPTION.

REED. A tall, stout, perennial grass, 5 to 15 feet (15-45 dm.) high, with stout, creeping rootstocks, numerous broad, attenuate-pointed leaves, and large, ovoid-pyramidal, purplish, terminal panicles, $\frac{1}{2}$ to 1 foot (15-30 cm.) long or more. Spikelets crowded on the ascending branches; empty glumes unequal, the first one-nerved, one-half to two-thirds as long as the three-nerved second one; flowering glumes 5 to 6 lines (10-12 mm.) long, three-nerved, long-acuminate, equalling the hairs of the rachilla. August to October.

Phragmites communis was common at one time in the northern half of the state and in southeastern Iowa. In central and northern Iowa it is rapidly disappearing because of the drainage of the numerous small ponds.

DISTRIBUTION.

Iowa. Forest City, 40 (Shimek); Pilot Mound, 3055 (Miss King and MacCorkindale); Ackley, 3272 (Hunt); Sioux City (Miss Wakefield); Jewell Junction, 1309 (Pammel); Fayette (Fink);

Ames (Crozier, Hitchcock, 758, Pammel and Cratty; 752, Pammel, Carver), Big Prairie, (Pammel); Emmet County, Armstrong, 1057 (Cratty); 10, Spirit Lake (Shimek); Greenfield (Stewart); Calhoun County (Rigg); Slater (Fawcett, Tener).



FIG. 152. *Phragmites communis*: a, spikelet; b, outer empty glumes; c, single floret showing palea, stamens and stigmas. (Div. Agros. U. S. Dept. Agr.)

North America. Abundant in swamps and wet places throughout the United States; from New England, New York (Parry), Ohio (Lancaster, Dr. Bigelow), to Florida; west to Alabama and Texas; north through the Rocky Mountains to Colorado (La Porte, Pammel), Utah (Duchesne River, Pammel and Stanton, 298), Nebraska, Minnesota (Centre City, Sandberg, 640), Wisconsin (La Crosse, Pammel), Dakota, Wyoming (Tensleep P. O., T. A. Williams), California to the Pacific Coast; from British Columbia to Manitoba and Nova Scotia.

General. Northern Europe, north temperate and tropical Asia, Africa, Australia, New Zealand, and in North America through Mexico to Central America.

3. TRIODIA.

Triodia R. Br. Prod. 182. 1810. Endlicher. Gen. Pl. 98. Bentham & Hooker. Gen. Pl. 3: 1175. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 68. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 128. f. 97. [Rev. Ed.]

Sieglingia Bernh. Syst. Verz. P. fl. Erf. 40. 1800. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 129. f. 98. [Rev. Ed.]

Rhombolytrum Link. Hort. Berol. 2: 296.

Tricuspis Beauv. Agrost. 77. pl. 15. f. 10.

Windsoria Nutt. Gen. Pl. N. Am. 1: 70.

Uralepis Fourn. Gram. Mex. 110.

Iridena Roem. & Schult. Syst. 2: 240.

Spikelets 3 to 12-flowered, somewhat terete, the rachis with bearded joints; terminal flower abortive. Empty glumes unequal; flowering glumes membranaceous or somewhat chartaceous, much larger than the 2-toothed palet, convex, 2 to 3-toothed or cleft at the apex, conspicuously hairy-bearded or villous on the 3 strong nerves, of which the lateral are marginal or nearly so and usually excurrent, as is the mid-nerve, especially, into a short cusp or awn. Stamens 3. Stigmas dark purple, plumose. Grain oblong, nearly gibbous. Leaves taper-pointed, sheaths bearded at the throat. Panicle simple or compound; the spikelets often racemose, purplish. (Name from the Greek words for *three* and *a tooth*; alluding to the flowering glume.)

Bentham & Hooker list 20 species, Hackel recognizes 26. Widely distributed throughout the temperate zones, and a few in tropical America. Nearly half the number of species occur in the United States, chiefly in Texas and southwestern territories; Beal lists 16 species and 2 varieties under *Sieglingia*.

KEY TO THE SPECIES OF TRIODIA.

Flowering glume 3-toothed by the excurrent nerves, usually with intermediate, tooth-like lobes, appearing 5-toothed *T. cuprea*. ¹.
Flowering glume 2-lobed, with the midnerve excurrent, palea ciliate.

—*T. purpurea*.²

1. TRIODIA CUPREA.

Triodia cuprea Jacq. Eclog. Gram. 2: 1814. Watson and Coulter. Gray. Man. Bot. 657. *pl.* 10. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 94. *f.* 122. 1896.

Sieglingia sesleroides (Michx.) Scribn. Beal. Grasses N. A. 2: 467. f. 93. 1896. Nash in Britton and Brown. Ill. Fl. 1: 184. f. 421. 1896.

Poa sesleroides Michx. Fl. Bor. Am. 1: 68. 1803.

DESCRIPTION.

TALL RED TOP. A stout, erect perennial, 3 to 5 feet (7-12 dm.) high, with long, flat leaves, and an ample, spreading, usually purple panicle, 6 to 12 inches (12-24 cm.) long. Culm leaves and sheaths glabrous; the sheaths at the base of the culm usually crowded and somewhat compressed. Lower leaves 1 to 2 feet (2-4 dm.) long, about $\frac{1}{4}$ inch (6 mm.) wide, very acute, usually hairy near the base; ligule very short, ciliate. Panicle ovate pyramidal, the widely spreading and drooping branches solitary or in pairs, naked below, axils bearded. Spikelets 4 to 7-flowered, 3 to 5 lines (7-12 mm.) long; empty glumes thin, broadly ovate, acute, 1-nerved, the larger second glume about 2 lines (4mm.) long; floral glumes about 2 lines (4 mm.) long, 3-nerved, oblong, hairy on the back below and on the marginal nerves for two-thirds their length, apex of the glumes four-lobed, the nerves projecting a little between the lobes. Palea a little shorter than the glumes, the keels strongly arched. In fields. July to September.

Triodia cuprea occurs only in southern and southeastern Iowa. It is found in clay soil, borders of fields and woods.



FIG. 153. *Triodia cuprea*—1, plant; 2, panicle; 3, spikelet; 4, floret; 5, floral glumes. (Holm Bull. U. Tenn.)

DISTRIBUTION.

Iowa. Decatur County (Fitzpatrick); Keokuk (P. H. Rolfs); Muscatine (Pammel and Reppert).

North America. In fields from New York, Alabama (Winston, Eggert), Florida (Duval County, Curtiss), Texas (Pammel; Dallas, Reverchon), Oklahoma (Kingfisher, Miller), southern Iowa, central Illinois, Missouri (St. Louis, Eggert; Jefferson Barracks and Valley Park, Pammel), Kansas (Comanche County, Carleton).

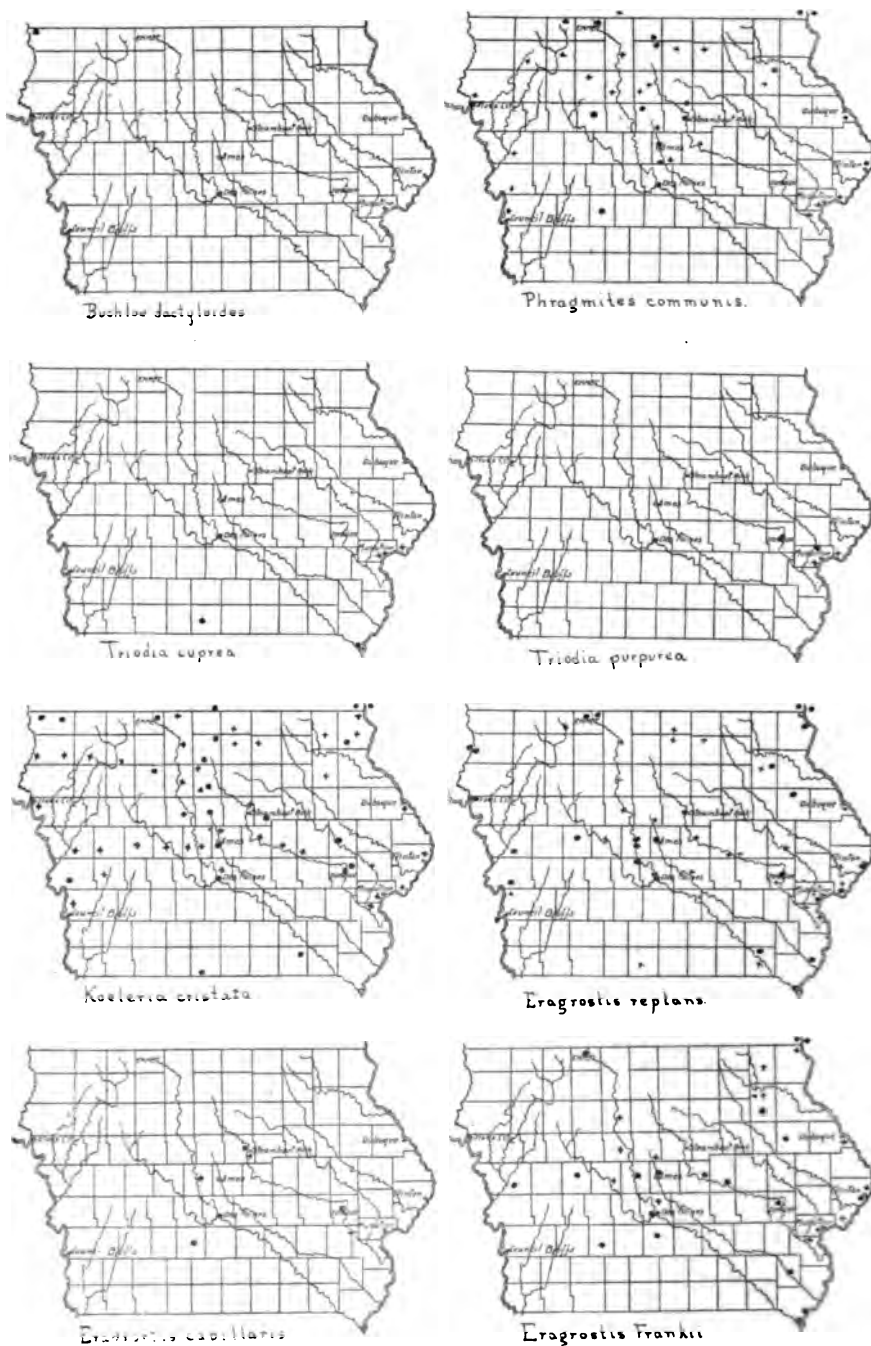


FIG. 154. Maps showing distribution of *Buchloe*, *Phragmites*, *Triodia*, *Koeleria* and *Eragrostis*. ● Specimens in Herbarium. + From observation.

2. TRIODIA PURPUREA.

Triodia purpurea Hack. Watson and Coulter. Gray. Man. Bot. 658. 1890. (6 ed.)

Tricuspis purpurea Gray. Man. Bot. 589. 1848. [Ed. 1.]

Sieglingia purpurea (Walt.) Kuntze. Beal. Grasses of N. A. 2: 469. 1896. Nash in Britton and Brown. Ill. Fl. 1: 185. f. 424. 1896

Triplasis purpurea Chapm. Fl. 560. 1860.

Triplasis purpurea (Walt.) Scribner. Bull. U. S. Dept. Agr. Div. Agros. 213. f. 509. 1899.

Aira purpurea Walt. Fl. Car. 78. 1788.



FIG. 155. *Triodia purpurea*—a, empty glumes; spike; c, empty glumes; d, flowering glumes. (Div. U. S. Dept. Agrl.)

FIG. 156. *Koeleria cristata*—a, spikelet; b, spikelet expanded. (Div. Agros. U. S. Dept. Agrl.)

SAND GRASS. A smooth, erect or spreading, caespitose perennial, 1 to 3 feet (3-9 dm.) high, with narrow, rigid leaves, and simple panicles 1 to 3 inches (2-6 cm.) long. Spikelets 2 to 5-flowered, $2\frac{1}{2}$ to 4

lines (5-8 mm.) long, with smooth, empty glumes and hairy, two-lobed and short-awned, flowering glumes. July-October.

Triodia purpurea occurs only in sandy soil in southeastern Iowa.

DISTRIBUTION.

Iowa. Moscow (Hitchcock); Iowa City (Hitchcock).

North America. In sandy soil Maine to Ohio (Painsville, Beardslee), North Carolina (McCarthy), Florida (Duval County, Curtiss), and along the Great Lakes; west to Nebraska (Hall and Harbour; Rock County, Clements, 2883), Texas and New Mexico.

5. KOELERIA.

Koeleria Pers. Syn. Pl. 1: 97. 1805. Scribner Bull. U. S. Dept. Agr. Div. Agros. 20: 136. *f.* 105. [Rev. Ed.]

Airochloa Link. Hort. Berol. 1: 126. 1827.

Collinaria Ehrh. Beitr. 4: 147. 1789.

Lophocloa Reich. Fl. Germ. Exc. 42. 1830.

Aegialitis Trin. Fund. Agrost. 127. 1820.

Aegialina Schultes. Syst. Mant. II. 13: 222. 1824.

Spikelets 3 to 7-flowered, crowded in a dense and narrow, spike-like panicle. Glumes membranaceous, compressed-keeled, obscurely 3-nerved, barely acute, or the flowering glume often mucronate or bristle-pointed; the empty ones moderately unequal, nearly as long as the spikelet. Stamens 3. Grain free. Tufted, with simple, upright culms, the sheaths often downy; allied to *Dactylis* and *Poa*. (Named for Prof. G. L. Koeler, an early writer on grasses.)

Bentham & Hooker give the number of species as 12; Hackel recognizes 15, the same number being given by Scribner, one only occurs in America. The genus is represented in Asia, northern Africa, North America and South America, but chiefly in Europe, Ritcher giving 16 species. These no doubt are in part mere forms of some of the polymorphic species.

1. KOELERIA CRISTATA.

Koeleria cristata Pers. Syn. 1: 97. 1805. Watson and Coulter. Gray Man. Bot. 659. *pl.* 10. [6th. Ed.]

Koeleria cristata (L.) Pers. Beal. Grasses of N. A. 2: 445. *f.* 99. 1894. Nash in Britton and Brown. Ill. Fl. 1: 194. *f.* 444. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 136. *f.* 105. 1900. (Rev. ed.)

Koeleria nitida Nutt. Gen. 1: 74. 1818.

Aira cristata L. Sp. Pl. 63. 1753.

DESCRIPTION.

KOELERIA. Spikelets two to four-flowered, compressed; rachilla articulated above the empty glumes. Empty glumes two, unequal, keeled, somewhat shorter than the flowering glumes; flowering glumes membranaceous, more or less scarious, faintly three to five-nerved, obtuse, acute or mucronate-pointed. Palea hyaline, acute, two-nerved, about as long as its glume. Stamens three. Styles very short; stigmas plumose. Perennial, caespitose grass, with narrow, usually flat leaves, and densely flowered, spike-like panicles. Dry, sandy soil. July to September.

Koeleria cristata in many forms is common throughout the state, usually in dry, sterile soil. See figure 156, page 221.

DISTRIBUTION.

Iowa. Cedar Rapids (Shimek); Ames (Zmunt, 179 Ball, Pammel, Miss Hess); Marathon, 3333 (Roberts); Pilot Mound (Miss King and A. MacCorkindale); Grundy Center, 3253 (Miss Paddock); Armstrong, 3262, 673 and 3199 Missouri Valley, 665 Elmore, Minn., Iowa-Minnesota line, 3221 Gridley (Pammel); Armstrong (Cratty); Rock Rapids, Johnson County, Cedar Rapids, Lyon County (Shimek); Allamakee County (Fitzpatrick and Bartsch); Hamilton to Hancock County (Preston); Johnson County (Miss Linder); Iowa City (Hitchcock and Macbride); Twin Lakes Township, Calhoun County (Rigg); Lyon County, northwest corner of state (Shimek); Unionville (Shimek); Lineville (Shimek); Ontario, (R. E. Buchanan).

North America. Ontario to British Columbia, south to Pennsylvania, Minnesota (Minneapolis, Sandberg, 213; Houston County, Pammel, 5; Iowa and Minnesota, Parry 3), Nebraska (Oxford 80, Sherman, Alma 73, Grand Island 110), Missouri (Jefferson, Eggert; Webster, Pammel), Kansas (Osborne, Shear 706), Wisconsin (La Crosse, C. M. King and D. S. Pammel), Texas and California (Parish, Santa Cruz, Dr. Anderson; southern California, Parry and Lemmon), Colorado (Greeley, La Poudre River, 41 Golden, 234, 249 Larimer County, 215 Ft. Collins Pammel; Hall and Harbour, lat. 39°-41'), Wyoming (Sheridan, Little and Stanton, 81, 184; Big Horn, 75, Sheridan; New Castle, 111, Pammel; Black's Fork, Fuller's Ranch, Pammel, Johnson, Buchanan and Lummis; Dale Creek and Black's Fork, Pammel and Buchanan; western Wyoming, Parry, 280); Utah (West Bear River 96, Provo River, Pammel and Stanton).

General. Great Britain, Germany, northern Europe and Asia, the Himalayas to Africa, temperate South America, Australia and New Zealand.

6. ERAGROSTIS.

Eragrostis Host. Ic. Gram. 4: 14. 1809. Bentham and Hooker. Gen. Pl. 3: 1186. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II 2: 69. f 79. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 134. f. 103. (Rev. ed.)

Poa in part. Endlicher Gen. Pl. 98.

Macroblepharus Philippi. L. 20: 100. 1855.

Harpachne Hochst. A. Rich. Fl. Abyssin. 2: 431. 1851.

Coelachyrum Nees. L. 16: 221. 1842.

Spikelets two to seventy-flowered, nearly as in *Poa*, except that the flowering glume is but three (rarely one) nerved, not webby-haired at the base, and is deciduous; palea persistent on the rachis after the rest of the flower has fallen. Culms often branching. Leaves linear, frequently involute, and the ligule or throat of the sheath bearded with long, villous hairs. Panicle various. (Name from two Greek words for *spring* and *grass*.)

Bentham & Hooker recognize 100 species; Hackel the same number; Beal lists 28, including varieties, in North America. The genus is cosmopolitan, found chiefly in the tropics.

KEY TO THE SPECIES OF ERAGROSTIS.

Culms prostrate and creeping, flowers imperfectly dioecious. *E. hypnoides*.¹
Culms usually diffusely spreading, ascending (or erect in *E. capillaris*), much branched, 4.5 dm. tall or less, usually annual.

Spikelets 2-5-flowered, 2-3 mm. long.

Culms branched only at the very base; pedicels and panicle branches long and capillary..... *E. capillaris*.²

Culms branched above the base; pedicels and panicle branches short..... *E. Frankii*.³

Spikelets 5 to many-flowered, 3-16 mm. long.

Spikelets 3 mm. wide, lower flowering glumes over 2 mm. long, plant strong-scented from button-shaped glands on leaves and glumes..... *E. major*.⁴*

Spikelets about 1.5 mm. wide, lower flowering glumes 1.5 mm. long, scentless..... *E. Purshii*.⁵

Culms erect, simple, panicles very large, 1 foot or more long.

Branches of the panicle widely spreading, lower flowering glumes less than 2 mm. long..... *E. pectinacea*.⁶

Branches of the panicle erect or ascending, lower flowering glumes 2.5-3 mm. long..... *E. trichodes*.⁷

*Spikelets about 2 mm. wide, scentless, occasionally cultivated in Iowa.

—*E. Mexicana*.^{8a}

1. ERAGROSTIS HYPNOIDES.

Eragrostis hypnoides B. S. P. Prel. Cat. N. Y. 69. 1888.

Eragrostis hypnoides Lam. B. S. P. Beal. Grasses of N. A. 2: 477. 1196. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 251. f. 245. 1900. (3d ed.)

Eragrostis reptans Nees. Agros. Bras. 514. 1829. Watson and Coulter. Gray. Man. Bot. 660. 1890. (6th ed.). Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 95. f. 123. 1896.

Poa hypnoides Lam. Ill. 1: 185. 1791.

DESCRIPTION.

CREeping, ERAGROSTIS. A prostrate,, much-brachd, and extensively creeping annual, with ascending flowering branches, 3 to 6 inches (6-13 cm.) high. Sheaths short, pubescent or smooth; ligule reduced to a fringe of short hairs, leaf-blade $\frac{1}{2}$ to 1 line (1-2 mm.) wide, usually



FIG. 157. *Eragrostis hypnoides*—a, b and d, spikelets; c, flower. (Div. Agros. U. S. Dept. Agrl.)



FIG. 158. *Eragrostis capillaris*—a, spike, b, spikelet. (Div. Agros. U. S. Dept. Agrl.)

about $\frac{1}{2}$ to $1\frac{1}{2}$ inches (1-3 cm.) long, more or less pubescent, acute, spreading. Panicle narrow, lax or dense, 1 to $1\frac{1}{2}$ inches (2-3 cm.) long, sometimes capitate. Spikelets linear-lanceolate, strongly flattened, 1 line (2 mm.) or less wide, 2 to 6 lines (4-12 mm.) long, ten to forty-flowered; empty glumes ovate, acute, the first a little longer than the second, hyaline excepting the prominent, green mid-nerve; flowering glume ovate-lanceolate, acute, $\frac{3}{4}$ to 1 line ($1\frac{1}{2}$ -2 mm.) long, prominently 3-nerved. Palea two-keeled, keels scabrous; grain spherical-oblong. In ditches and sandy banks of streams. July to October.

Eragrostis hypnoides is abundant on the wet shores of the present flood plains of our streams near the water, or on the banks of lakes.

DISTRIBUTION.

Iowa. Ames, 3197 (Hunt and Rolfs); 3254 and 3140, Lansing (Miss King); Ames, 905 (Ball, Beardslee, Kaufman, Hitchcock, Pammel); Johnson County (Shimek); Carroll 1099, Marshalltown 239 Clinton, Hawarden, 630 Des Moines, Missouri Valley, Story City, 1032 Turin, Des Moines, Boone (Pammel); 1098 Boone, Winterset (Carver); Ledges, Boone County, 108 (Pammel and Ball); Dallas Center, 751 (Rhinehart); Manchester, 754 (Ball); Sioux City (Miss Wakefield); Keokuk (P. H. Rolfs); Birmingham, 1039 (Baldwin); Wadena (Fink); Emmet County (Armstrong, Cratty); High Bridge, Dallas County (Shimek); Story County (Hitchcock); Iowa City (Miss Linder); Des Moines County (Bartsch); Johnson County (Shimek).

North America. Vermont to Ontario and south to Kentucky (Harlan County, Cumberland River, Kearney, 55), Illinois (Indian Lake, Eggert), Minnesota (Parry), Missouri (Jefferson Barracks, Pammel), Texas (Joor), Mexico (San Luis Potosi, Palmer), California and Washington.

General. West Indies, Trinidad to Argentina.

2. ERAGROSTIS CAPILLARIS.

Eragrostis capillaris Nees. Agrost. Bras. 505. 1829. Watson and Coulter. Gray. Man. Bot. 661. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. of Tenn. Agr. Exp. Sta. 7: 96. *f.* 128. 1894.

Eragrostis capillaris (L.) Nees. Beal. Grasses of N. A. 2: 481. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 218. *f.* 514. 1896. Nash in Britton and Brown. Ill. Fl. 1: 188. *f.* 428. 1896.

Poa capillaris L. Sp. Pl. 68. 1753.

Poa tenuis Ell. Bot. S. C. & Ga. 1: 156.

DESCRIPTION.

CAPILLARY ERAGROSTIS. An erect annual, 6 to 25 inches (15-60 cm.) high, branching at the base, the widely expanding panicle usually much longer than the culm below it. Sheaths and base of leaves more or less hairy, sometimes glabrous; ligule a minute fringe of hairs; leaf-blade 4 to 12 inches (10-30 cm.) long, $\frac{3}{4}$ to 2 lines (2-5 mm.) wide. Spikelets three to five-flowered, 1 line (2 mm.) or less long; empty glumes about $\frac{1}{2}$ line (1 mm.) long, equal, hispid on the keel, acute; flowering glume ovate-lanceolate, acute, obscurely 3-nerved, about $\frac{3}{4}$ line ($1\frac{1}{4}$ mm.) long. Palea rough-ciliate on the keels. Grain nearly spherical. The spreading panicle-branches and long, diverging pedicels capillary. Dry, sandy fields, sandy woods and roadsides. August, September.

Eragrostis capillaris is local in its distribution, and occurs only on the carboniferous sandstones and talus in central and eastern Iowa. See figure 158, on page 225.

DISTRIBUTION.

Iowa. Ledges, Boone County, 557 Iowa City (Hitchcock); Winterset, 253 (Carver); Steamboat Rock (Shimek).

North America. From New England to New York; Kentucky (Harlan County, Kearney, 196), south to Georgia, Texas and Florida (Duval County, Curtiss), Missouri (St. Louis, Pammel), Iowa.

General. Brazil.

3. ERAGROSTIS FRANKII.

Eragrostis Frankii Steud. Syn. Pl. Gram. 273. 1854-5. Nash in Britton and Brown. Ill. Fl. 1: 188. f. 429. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Aros. 7: 253. f. 247. 1900. (3d ed.)

Eragrostis Frankii Meyer. Watson & Coulter. Gray. Man. Bot. 661. 1890. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 96 f. 125. 1894. Beal. Grasses of N. A. 2: 480. 1896.

Eragrostis erythrogona Nees. Steud. Syn. Pl. Gram. 273. 1855.

DESCRIPTION.

SHORT STALKED MEADOW GRASS. A low, diffusely-branched annual, 3 to 15 inches (6-32 cm.) high. Sheaths pilose at the throat; ligule less than 1 line (2 mm.) long, lacerated; leaf-blade $\frac{3}{4}$ to 2 lines ($1\frac{1}{2}$ -4 mm.) wide; 1 to 7 inches (2-14 cm.) long; flat or conduplicate towards the apex. Panicle ovate or oblong, with spreading, capillary branches and pedicels, the latter mostly longer than the spikelets. Spikelets ovate, about 1 line (2mm.) long, three to five-flowered; empty glumes spreading,

lanceolate, acute, scabrous on the keel, about $\frac{1}{2}$ line (1 mm.) long; flowering glume ovate, acute, obscurely three-nerved. Keels of the palea scabrous. Grain short, oblong. Remarkable for its strong, disagreeable odor when fresh. Low, sandy ground. August to October:

Eragrostis Frankii is common in trodden fields, banks of streams and in woods, eastern and central Iowa.



FIG. 159. *Eragrostis Frankii*—a, b, and c. FIG. 160. *Eragrostis major*—a, spikelet; b, spikelet. (D v. Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. Ames (Pammel 170, Rolfs, Hitchcock, Carver, Pammel and Carver, Bessey); Indianola, Ames (Carver); Montrose, 818 (H. Osborn); Marshalltown (Stewart); Keokuk (P. H. Rolfs); Mt. Pleasant (Mills); Emmet County, 866 (Pammel and Cratty); Mt. Pleasant, 991 (Witte); Manchester, 753 (Ball); 295 and 169, Ledges, Boone County (Pammel and Ball); Fayette County (Fink);

Greenfield (Stewart); Johnson County (Shimek); Marshalltown, Carroll, Turin, Des Moines, Clinton (Pammel); Armstrong, Emmet County (Cratty); Johnson County (Hitchcock and Macbride), Marshalltown (Pammel).

North America. Southern New York to Minnesota; Kentucky (Harlan County, Kearney, 150), Illinois (Bebb; Palatine, Pammel; Chicago, Pammel), Missouri (Rock Springs, Eggert); south to Georgia, Louisiana and west to Kansas.

4. ERAGROSTIS MAJOR.

Eragrostis major Host. Gram. Austr. 4: 14. *pl.* 24. 1809. Watson and Coulter. Gray. Man. Bot. 660. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 97. *f.* 124. 1894. Bull. U. S. Dept. Agr. Div. Agros. 17: 215. *f.* 511. 1899. Beal. Grasses of N. A. 2: 486. 1896. Nash in Britton and Brown. Ill. Fl. 1: 189. *f.* 433. 1896.

Eragrostis poaeoides var *megastachya* A. Gray. Man. Bot. 631. 1867. (5th ed.)

DESCRIPTION.

CANDY GRASS. A rather showy, much-branched annual, with erect or ascending stems, 6 inches to 2 or 3 feet ($1\frac{1}{2}$ -5 or 14 dm.) high. Sheaths striate, smooth, hairy at the throat; ligule a fringe of short hairs, leaf-blade flat, 3 to 10 inches (6-20 cm.) long, 1 to 3 lines (2-6 mm.) wide, somewhat scabrous on the upper surface. Panicle elliptical or oblong, the branches usually spreading, spikelets ovate to linear, seven to forty-flowered, 2 to 8 lines (4-16 mm.) long, $1\frac{1}{2}$ to 2 lines (3-4 mm.) broad; empty glumes nearly equal, ovate, lanceolate, 1 line (2 mm.) or less long; flowering glumes ovate, obtuse, prominently nerved, and scabrous on the keel. Palea ciliate on the keels. June to October. See figure 160, on page 228.

Eragrostis major is a weedy grass in all parts of the state. Introduced by the earliest settlers.

DISTRIBUTION.

Iowa. Granite (Shimek); High Bridge (Lummis); Forest City (Shimek); Ames (Zmunt, C. A. Wilson, Beardslee); Fairfield (Bessey); Weaver (Hitchcock); Armstrong (Cratty); Greenfield (Stewart); Lee County, Des Moines County (Bartsch); Cedar Rapids (Miss Hall); 20 Granite, Keokuk, Johnson County (Shimek); Hamilton to Hancock County (Preston); Creston (Bettenga); 3149 Lansing, 3040 Steamboat Rock, 3350 Postville, 3327 Myron (Miss King); Battle Breek, 958 (Preston); Montrose, 765 (H. Osborn);

Amana, 703 (Schadt); Manchester, 721 (Ball); Granite, 17 (Shimek); Lake Edwards, Hancock County 8 (Shimek); Ames, 161 (Ball); Camanche (Ball); Wheatland (Ball); Mt. Ayr (Beard); Carroll, Logan, Council Bluffs, Jefferson, Dakota City, South Dakota opposite Hawarden, 801 Des Moines, 292 Carnarvon, Turin, Clinton (Pammel); Lake Edwards, Hancock County, 8 (Shimek); Emmet County, 1052 (Cratty); Harcourt, 1095 (Danielson); Le Claire (F. M. Rolfs); Iowa City (Hitchcock); Lawler, Keokuk (P. H. Rolfs); Maquoketa (Goodenow); Marshalltown (Eckles); Colfax (Mead); Fayette (Fink); Taylor County (Pool); Dixon, 736 and 714 (Snyder); Glenwood, 693 (Jackson); Mt. Pleasant, 687 (Witte); Des Moines, 30 (Ball); Boone, Indianola, Jewell Junction (Carver); Keystone (Koch); Marshalltown (Stewart); Decatur County (Fitzpatrick); Belknap, 822 (Rankin); Muscatine (Reppert); Alden, 1155 and 1131 (Stevens); Jewell Junction (Carver); Carnforth (Pammel); Keosauqua (Shimek); Traer (Provan).

North America. Naturalized in cultivated and waste grounds. Ontario to New England to New Jersey (Rariton Landing, Halsted), Minnesota (Crow Wing, Sandberg, 864), Wisconsin (La Crosse, D. S. Pammel and C. M. King), Missouri (St. Louis, Pammel; St. Louis, Eggert), Nebraska (Snyder, Miller; Aurora, McCook; Pammel), South Dakota (Randall, Griffith), Indian Territory (near Ft. Smith, Arkansas, Rolfs); Texas (Pammel), Colorado (Larimer County, Frye; Denver, Pammel, Lummis, Johnson and Buchanan, 909), Wyoming (Green River, S. M. Tracy), Mexico (Parry and Palmer).

General. Central Europe, Asia and Africa.

4-A. ERAGROSTIS MEXICANA.

Eragrostis Mexicana Link. Hort. Berol. 1: 190. Nees. Agrost. Bras. 503. Doel. in Mart. Fl. Bras. 2: 3. 143. Fourn. Mex. Pl. Enum. Gram. 114. Watson Am. Acad. 18: 182.

DESCRIPTION.

MEXICAN ERAGROSTIS. Culms 1 to 2 feet (3-6 dm.) high, panicle oblong; branches smooth, single or somewhat verticillate, ascending; 5 inches (1 dm.) long, or less; spikelets four to ten-flowered, 1 to 3 lines (3-6 mm.) long; empty glumes half as long as the contiguous florets; floral glume subacute, hispidulous on the keel, one-fourth longer than the hispidulous palea; grain oblong, oblique, nearly smooth under a glass, about 0.8 mm. long.



FIG. 161. *Eragrostis Mexicana*—a, spikelet; b, flowering glume; c, palea, d, seed.
(Charlotte M. King.)

DISTRIBUTION.

Iowa. Ames, escaped from cultivation, 306 (Pammel).

North America. Western Texas to southern California.

5. ERAGROSTIS PURSHII.

Eragrostis Purshii Schrad. *Linnaea*. 12: 451. 1838. Watson and Coulter. *Gray. Man. Bot.* 661. 1890. (6th ed.) Scribner. *Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta.* 7: 97. f. 126. 1894. Nash in Britton and Brown. *Ill. Fl.* 1: 189. f. 431. 1896. Scribner. *Bull. U. S. Dept. Agr. Div. Agros.* 7: 247. f. 241. (3d ed.)

Eragrostis pilosa L. Beal. *Grasses of N. A.* 2: 487. 1896.

Poa Caroliniana Spreng. *Mant. Fl. Hal.* 33. 1807.

Eragrostis Caroliniana Scrib. *Mem. Torr. Bot. Club.* 5: 49. 1895.

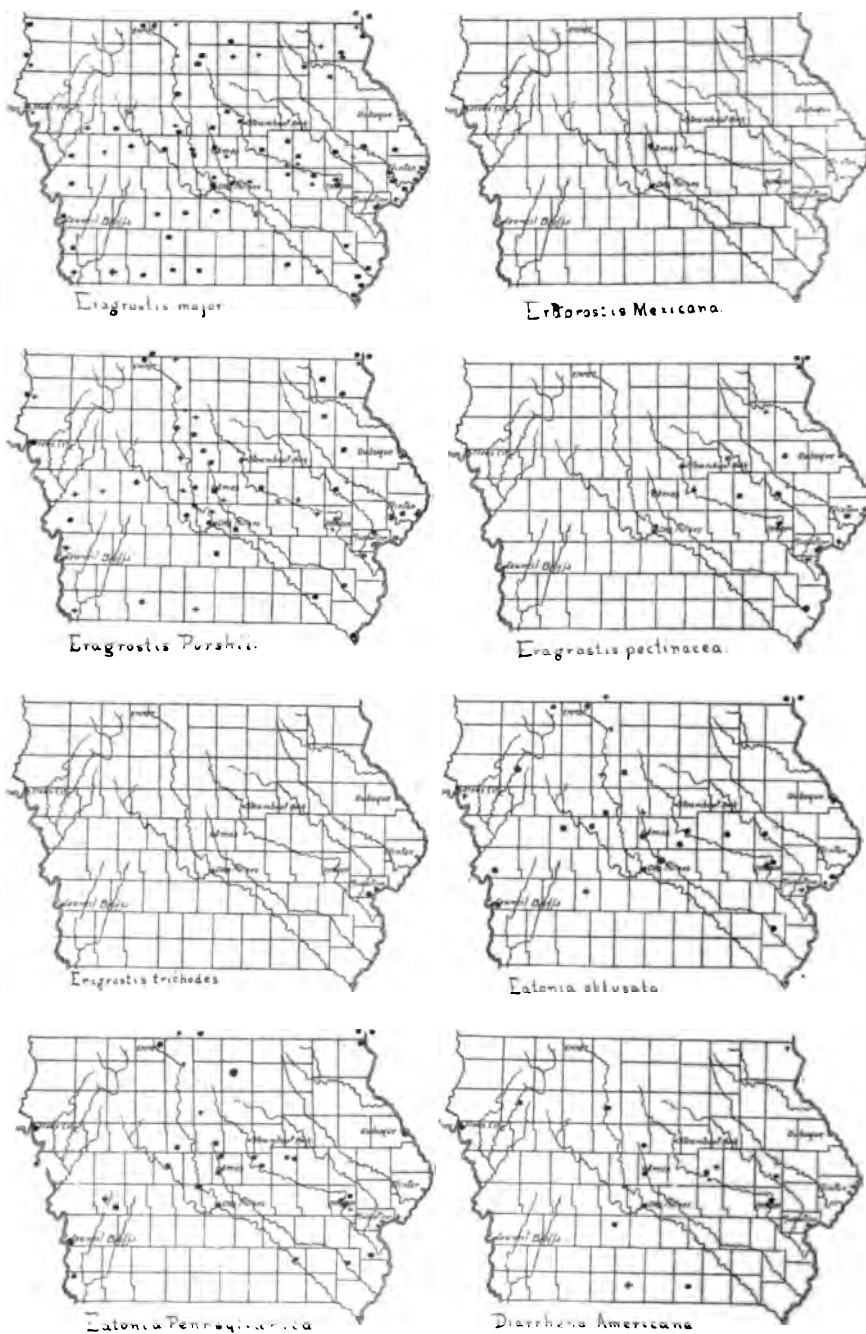


FIG. 162. Maps showing distribution of *Eragrostis*, *Eatonia* and *Diarrhena*.
 • In herbarium. + From observation.

DESCRIPTION.

SOUTHERN SPEAR GRASS. An annual, 5 to 18 inches (1-4 dm.) high, with the erect or ascending stems diffusely branching near the base. Sheaths pilose at the throat, otherwise smooth, leaf-blade 1 to 7 lines (2-14 mm.) long; $\frac{1}{2}$ to $1\frac{1}{2}$ lines (1-3 mm.) wide, conduplicate when dry. Panicle oblong-lanceolate to pyramidal, 3 to 8 or 12 inches (6-16 or 24 cm.) long, the widely spreading primary branches solitary

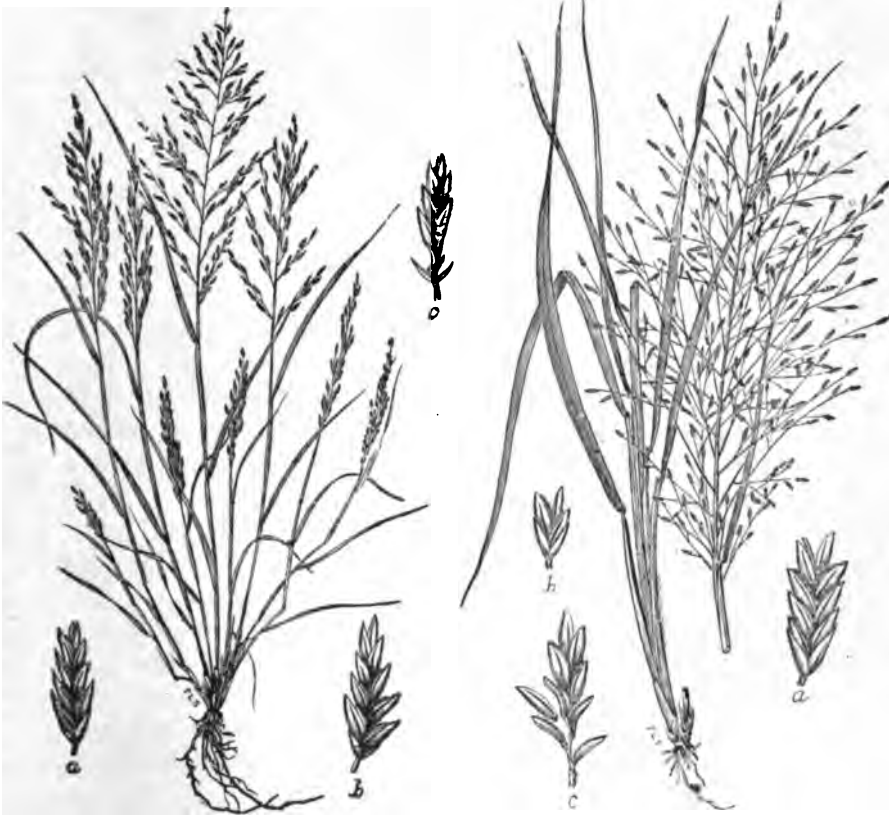


FIG. 163. *Eragrostis Purshii*—a, b, c, spikelets. (Div. Agros. U. S. Dept. Agrl.)

FIG. 164. *Eragrostis pectinacea*—a, b, c, spikelets. (Div. Agros. U. S. Dept. Agrl.)

or two to three together, the axils not pilose. Spikelets narrow-lanceolate, 2 to $4\frac{1}{2}$ lines (4-9 mm.) long, three to fifteen-flowered, appressed to the branches, nearly equalling or exceeding their capillary pedicels; empty glumes ovate, acute, scabrous on the keel, the longer upper one about $\frac{1}{2}$ line (1 mm.) in length; flowering glume broadly ovate, obtuse,

distinctly three-nerved, scabrous on the keel, about $\frac{3}{4}$ line ($1\frac{1}{2}$ mm.) long. Palea scabrous on the keels. Grain oblong. June to October.

Eragrostis Purshii is a common roadside weed in all parts of the state. The species occurs along roadsides, railroad embankments, and is abundant in flood plains of streams.

DISTRIBUTION.

Iowa. Musactine, 34 (Ball); Winneshiek County (Goddard); Steamboat Rock, 3170, 3355, Postville (Miss King); 3289, Boone Viaduct (Pammel); Dallas Center, 751 (Rhinehart); Wilton Junction, 2249, 2224, Webster City, Marshalltown, Carroll, Ames, Sioux City, Clinton, Eagle Grove, 1452 De Witt, South Dakota, opposite Hawarden, 789 Dakota City, 788 Marshalltown, Cedar Rapids, Logan (Pammel); Ames (C. A. Wilson, Sirrine, Gossard and Rich, Arthur, Pammel, Kaufman, Beardslee, Hitchcock, Stewart); Fairfield, 162 (Ball and Sample); Fayette County (Fink); Indianola, Jewell Junction, Des Moines, Boone (Carver); Mt. Pleasant (Mills); Fairmont, Silver Lake, State Line (Cratty); Keokuk, Johnson County (Shimek); Keokuk (P. H. Rolfs); Taylor County, 1113 (Pool); Manchester, 723 (Ball); Muscatine (Reppert); Fairmont, Minn., 7, near Iowa-Minnesota line (Cratty); Manchester (Ball); Cedar Rapids (Miss Hall); Dixon, 717 (Snyder); Clinton, 270 (Ball); Birmingham, 846 (Baldwin); High Bridge, Dallas County (Shimek); Iowa City (Atwood, Macbride, Hitchcock); Hamilton to Hancock County (Preston).

North America. Ontario and Maine, Florida (Quincy, Combs, 432), to Kentucky (Harlan County, Kearney, 28), Illinois (Pullman, Pammel; Le Claire County, Eggert), Wisconsin (La Crosse, C. M. King and D. S. Pammel; L. H. Pammel, 3258), South Dakota, Nebraska (Knox County, Clements, 2731; Broken Bow, Webber; Hastings, Pammel), Indian Territory (near Ft. Smith, Ark., P. H. Rolfs), Texas (Sherman, Pammel), Colorado (Alamosa, Clements 153), California, Mexico (Parry and Palmer).

6. ERAGROSTIS PECTINACEA.

Eragrostis pectinacea Steud. Syn. Pl. Gram. 272. 1854.

Eragrostis pectinacea Gray. Watson and Coulter. Gray. Man. Bot. 661. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 98. f. 131. 1894.

Eragrostis pectinacea (Michx.) Nees. Beal. Grasses of N. A. 2: 488. 1896.

Eragrostis pectinacea (Michx.) Steud. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 249. f. 243. (3d ed.)

Poa pectinacea Michx. Fl. Bor. Am. 1: 69. 1803.

DESCRIPTION.

MEADOW COMB GRASS. An erect perennial, 1 to 3 feet (5-11 dm.) high, with a short, stout root-stock, and a large, spreading panicle. Sheaths smooth or hairy in the upper part; ligule a fringe of hairs 2 to 3 lines (4-6 mm.) long; leaf-blade 2 to 3 lines (4-6 mm.) wide, 6 to 14 inches (1½-3 dm.) long, more or less pilose on the upper surface. Panicle 6 to 30 inches (1½-8 dm.) long, the rather rigid, widely spreading or deflexed branches bearded in the axils. Spikelets linear-lanceolate, ¾ to 1 line (1½-2 mm.) wide, 2 to 5 lines (4-10 mm.) long, five to twenty-flowered; empty glumes ¾ to 1 line (1½-12 mm.) long, ovate or oblong, subacute, scabrous on the keel; flowering glumes about 1 line (2 mm.) long, strongly three-nerved, obtuse or rarely acute. Palea densely ciliate on the keels. Grain oblong-spherical, irregularly striate. July to October. See figure 164, on page 233.

Eragrostis pectinacea occurs in sandy or gravelly soil. Common on Muscatine Island and sand dunes along the Mississippi River, in central Iowa found in gravelly soil. It is not, however, abundant.

DISTRIBUTION.

Iowa. Des Moines, 3282 Steamboat Rock (Pammel); Manchester, 722 (Ball); New Albin, 900 (Pammel); Muscatine (Reppert); Waterloo (Hitchcock); Ames (Bessey, Hitchcock); Cedar Rapids (Miss Hall); Des Moines, 309 (Carver); Cedar Rapids, Des Moines, 1447 De Witt (Pammel); Des Moines County, Skunk River (Bartsch); Keystone (Koch).

North America. Massachusetts to Illinois (Dr. Geo. Vasey), Wisconsin (La Crosse, D. S. Pammel and C. M. King, 3320, 3325; Pammel), South Dakota, Nebraska (Crete and McCook, Pammel, 240, 399), Missouri (Carson Station, Eggert; Valley Park, Old Orchard and St. Louis, Pammel), Kansas (Barber County, Carleton), Arkansas (Miller County, Eggert), North Carolina (Dunn Mt., Small) to Florida, Mississippi (Starkville, Tracy; Biloxi, Eggert), Texas (Dallas, Reverchon).

7. ERAGROSTIS TRICHODES.

Eragrostis trichodes Nash. Bull. Torr Bot. Club. 22: 464. 1895.

Eragrostis trichodes (Nutt.) Nash. Nash in Britton and Brown. Ill. Fl. 1: 191. f. 418. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 217 f. 515. 1899.

Eragrostis tenuis Gray. Man. Bot. 664. 1856. (2nd ed.) Watson and Coulter. Gray. Man. Bot. 661. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: f. 129. 1894.

Eragrostis tenuis (Ell.) Gray. Beal. Grasses of N. A. 2: 483. 1896.

DESCRIPTION.

HAIR LIKE ERAGROSTIS. A tall perennial, 2 to 5 feet (5-14 dm.) high, with a rather narrow, elongated panicle, and somewhat rigid leaves. Sheaths firm, smooth, pilose at the throat; ligule nearly wanting; leaf-



FIG. 165. *Eragrostis trichodes*—a, b, spikelets; (Div. Agros. U. S. Dept. Agrl.)



FIG. 166. *Eragrostis obtusata*—a, empty glumes; b, c, d, flowering glumes; d, spikelet. (Div. Agros. U. S. Dept. Agrl.)

blade 1 to 2 lines (2-4 mm.) wide, 6 to 20 inches (1½-4 dm.) long, glabrous to sparingly hairy. Panicle twelve to thirty inches long, the ultimate branches and long, diverging pedicels capillary. Spikelets ovate-lanceolate, about 1½ lines (3 mm.) wide, 3 to 4 lines (6-8 mm.) long, two to six or ten-flowered; empty glumes narrow-lanceolate, very acute, nearly equal, 1 to 2 lines (2-4 mm.) long; flowering glume ovate-lanceolate, acute, strongly three-nerved, about 1½ lines (3 mm.) long, smooth or scabrous on the keel. Keels of the palea scabrous. Grain very short, oblong, strongly grooved. July to September.

Eragrostis trichodes is a very local grass, occurring only on sandy beaches, Muscatine Island.

DISTRIBUTION.

Iowa. Fruitland (Barnes and Miller); Muscatine (Reppert).

North America. Illinois to Nebraska, Missouri (Carson Station, Eggert), Indian Territory and Texas (College Station, Pammel).

7. EATONIA.

Eatonia Raf. Journ. Phys. 89: 104. 1819. Endlicher Gen. Pl. 99. Bentham & Hooker. Gen. Pl. 3: 1184. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 70. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 135. f. 104. [Rev. Ed.]

Reboulea Kunth. Rev. Gram. 341. 1835.

Colobanthus Trin. Mem. Acad. Petr. II. 6: 66. 1845.

Spikelets usually two-flowered, with an abortive rudiment or pedicel; numerous, in a contracted or slender panicle, very smooth, empty glumes somewhat equal in length, but very dissimilar, a little shorter than the flowers; the lower narrowly linear, keeled, one-nerved; the upper broadly obovate, folded around the flowers, three-nerved on the back, not keeled, scarious-margined. Flowering glume oblong, obtuse, compressed-boat-shaped, naked, chartaceous; the palea very thin and hyaline. Stamens 3. Grain linear-oblong, not grooved. Perennial, tall and slender grasses, with simple, tufted culms, and often sparsely downy sheaths, flat lower leaves, and small greenish (rarely purplish) spikelets. (Named for Prof. Amos Eaton, author of a popular Manual of the Botany of the United States, and of other popular treatises.)

According to Bentham & Hooker and Hackel there are two or three species; this number should be increased to 4; Beal recognizes 6 species.

(Pammel); Keystone (Koch); Iowa City (Hitchcock); Mt. Pleasant, 855 (Mills); Cherokee (Wakefield); Harcourt (Danielson); Marathon (Roberts); Davenport, Cedar Rapids, Spirit Lake (Shimek); Johnson County (Hitchcock and Macbride).

North America. Massachusetts, District of Columbia (Washington, Vasey), Nebraska (Thedford, Webber; McCook, 275, 356, 360, 365, 368, 372; Hastings, Grand Island, Alma, Broken Bow, Pammel), Texas, New Mexico (Vasey), Florida (Duval County, Curtiss, 3462), Colorado (Ft. Collins, Pammel), Montana (Craig), and southern California.

2. EATONIA PENNSYLVANICA.

Eatonia Pennsylvanica Gray. Man. 558. 1856. (2d ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 99. f. 133. 1896.

Eatonia Pennsylvanica (D C.) ray. Beal. Grasses of N. A. 2: 1896, Nash in Britton and Brown. Ill. Fl. 1: 193 f. 442. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 257. f. 251. 1900. (3d ed.)

Koeleria Pennsylvanica D C. Cat. Hort. Monsp. 117. 1813

DESCRIPTION.

PENNSYLVANIA EATONIA, EATON'S GRASS. A slender, pale-green perennial, with flat leaves and narrow, terminal panicles. Sheaths mostly smooth; ligule about 1 line (2 mm.) long; leaf-blade 1 to 2 lines (2-4 mm.) wide, 3 to 4 inches (6-9 cm.) long, flat, scabrous on both sides. Panicle slender, 3 to 7 inches (7-15 cm.) long, the branches nearly erect. Spikelets scattered along the branches, two or occasionally three-flowered; empty glumes a little over 1 line (2 mm.) long; the lower narrowly linear with scabrous keel, the upper narrowly obovate, acute or obtuse, slightly scabrous on the nerves. Flowering glume about 1½ lines (3 mm.) long, acute, somewhat scabrous on the back above. Leaves of about equal length throughout. Wet meadows, low woods and thickets. June to August.

Eatonia Pennsylvanica is found throughout the state in low grounds, growing in tufts. Not of much value as a forage plant.

DISTRIBUTION.

Iowa. Marshalltown, 518 (R. B. Eckles); Harcourt (Danielson); Iowa City (Hitchcock); Mt. Pleasant (Mills); Tama County, 961 (Sirriner); Harcourt, 1088 (Danielson); Morning Sun, 1105 (Carver); Armstrong (Cratty); Beaver, 3250 (Pammel and Kinzer);



FIG. 167. *Eatonia Pennsylvanica*—a, spikelet; b, empty glumes; c, spikelet. (Div. Agros. U. S. Dept. Agrl.)



FIG. 168. *Diarrhena Americana*—a, spikelet; b, empty glumes; c, flowering glumes. (Div. Agros. U. S. Dept. Agrl.)

Sioux City 1279, Council Bluffs, Dubuque, 1919 New Albin, Jefferson 1364, Ottumwa, Story City 1041, Elmore, Minne. (Iowa-Minnesota line), Marshalltown (Pammel); Ames (Hitchcock, Pammel, Fisher, Beardslee, 167 Ball, P. H. Rolfs); Shelby County (Fitzpatrick); Dysart (Sirriner); Bartlett (Chambers); Iowa City (Hitchcock); Jewell Junction (Carver); High Bridge, Dallas County (Shimek); Clear Lake, Johnson County (Shimek, Miss Linder); Hamilton to Hancock County (Preston).

North America. Newfoundland and Maine to Washington, south to Georgia, Texas and Arizona; west to Wisconsin (La Crosse, Pammel), Minnesota (Aitkin County, Sandberg), Missouri (Webster and Valley Park, Pammel; St. Louis, Forest Park, Eggert), Colorado (Ft. Collins, Pammel), Wyoming (Sheridan County, Pammel).

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8. DIARRHENA.

Diarrhena Beauv. Agros. 142. 1812. Raf. Jour. Phys. 89: 104. 1819. Endlicher Gen. Pl. 102. Bentham & Hooker. Gen. Pl. 3: 1190. Hackel in Engle & Prantl. Nat. Pflanz. Fam. II. 2: 70.

Festuca Michx. Fl. Bor. Am. 1: 67. *pl.* 10. 1803.

Korycarpus Scribner. Bull. U. S. Dept. Agrl.

Spikelets several flowered, smooth and shining; one or two of the uppermost flowers sterile. Empty glumes ovate, much shorter than the flowers, coriaceous; the lower much smaller; flowering glume ovate, convex on the back, rigidly coriaceous, its three nerves terminating in a strong and abrupt, cuspidate or awl-shaped tip. Squamulae ovate, ciliate. Stamens 2. Grain very large, obliquely ovoid, obtusely pointed, rather longer than the glume, the cartilaginous, shining pericarp not adherent to the seed. A nearly smooth perennial, with running rootstocks, producing simple culms, 2 to 3 feet (4-10 dm.) high, with long, linear-lanceolate, flat leaves towards the base, naked above, bearing a few short-pedicelled spikelets 2 to 3 lines (4-6 mm.) long, in a very simple panicle. (Name composed of two Greek words for *two* and *man*, from the two stamens.)

Bentham & Hooker recognize two species; the same number is given by Hackel. The *Diarrhena Americana* occurs in eastern North America, while the *Diarrhena Japonica* is native to Japan.

1. DIARRHENA AMERICANA.

Diarrhena Americana Beauv. Agrost. 142. 1812. Watson and Coulter. Gray. Man. Bot. 662. *pl.* 10. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 101. *f.* 137. 1894.

Korycarpus diandrus (Michx.) Kuntze. Beal. Grasses of N. A. 2: 511. *f.* 102. 1896. Nash in Britton and Brown. Ill. Fl. 1: 196. *f.* 449. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 268. *f.* 362. 1900. (3d ed.)

Korycarpus arundinaceus Zea. Acr. Matrit. 1806.

Festuca diandra Michx. Fl. Bor. Am. 1: 67. *pl.* 10. 1803.

DESCRIPTION.

TWIN GRASS. An erect perennial, 2 to 3 feet (5-7 dm.) high, with long, narrow-lanceolate, nearly erect leaves, and a few flowered, simple panicle, 4 to 10 inches (9-22 cm.) long. Sheaths scabrous or sometimes pubescent above; ligule very short, rigid; leaf-blade 6 to 24 inches (12-48 cm.) long, 5 to 12 lines (10-24 mm.) wide, tapering to a narrow base, very long acuminate-pointed. Panicle-branches erect. Spikelets 3 to 5 lines (6-10 mm.) long, three to six-flowered, the upper

most flowers imperfect; flowering glumes three-nerved, abruptly and sharply acuminate-pointed. Palea broad, two-keeled, keels scabrous. Grain about 3 lines (6 mm.) long, enlarged near the middle. Floral glumes spreading in fruit. August to September. See figure 168 on page 240.

Diarrhena is widely distributed in the state.

DISTRIBUTION.

Iowa. Ames (Gossard and Rich, Pammel, Ball 137, Bessey, Hitchcock, Carver, Fisher); Winterset 1060, Jewell Junction (Carver); Decatur County (Fitzpatrick); Dakota City (Pammel); Cherokee, Sioux City (Miss Wakefield); High Bridge, Dallas County (Shimek); Johnson County (Miss Linder); Iowa City (Macbride); Davenport (Parry).

North America. Rich, rocky, wooded hillsides, Ohio (Columbus, Sullivan; Lancaster, Dr. Bigelow), to South Dakota, south to Georgia, Arkansas and Indian Territory, Missouri (Pacific, Eggert).

9. MELICA.

Melica L. Sp. Pl. 66. 1753. Endlicher Gen. Pl. 100. Bentham and Hooker. Gen. Pl. 3: 1189. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 70. f. 81. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 138. f. 107. [Rev. ed.] Beauv. Agrost. 68. pl. 14. f. 4. Kunth. Enum. 375. pl. 1.

Chondrachyrum Nees. Lindl. Introd. Nat. Syst. 449. (2 ed.)

Spikelets two to eight-flowered; the 1 to 3 upper flowers imperfect and dissimilar, convolute around each other, and enwrapped by the upper fertile flower. Empty glumes usually large, scarious margined, convex, obtuse; the upper 7 to 9-nerved. Flowering glume papery-membranaceous, dry and sometimes indurated with age, rounded or flattish on the back, five to many-nerved, scarious at the entire blunt summit. Stamens 3. Perennials, with soft, flat leaves. Panicle simple or sparingly branched; the rather large spikelets racemose, one-sided. (An old Italian name for sorghum, from *mel*, honey.)

Bentham & Hooker give the number of species at 30, while Hackel gives the same number. Beal recognizes 22 species and 5 varieties for North America. The genus is found chiefly in temperate regions of Europe, Asia and America. One species is cultivated for ornamental purposes. Most of our species of *Melica* are western. One species extends as far north as southeastern Minnesota.

KEY TO THE SPECIES OF MELICA.

Upper empty glume much shorter than the 3-5 flowered spikelet.

Spikelets usually numerous, panicle branches spreading or ascending.

—*M. diffusa*.¹

Spikelets few, panicle branches erect.....*M. parviflora*.²

Upper, empty glume nearly or quite equaling the 2-flowered spikelet.

--*M. mutica*.³

1. MELICA DIFFUSA.

Melica diffusa Pursh. Fl. Am. Sept. 1: 77. 1814. Watson and Coulter. Gray Man. Bot. 862. 1890. (6 ed.) Beal. Grasses of N. A. 2: 502. 1896. Nash in Britton and Brown. Ill. Fl. 1: 195. f. 446. 1896.

Melica mutica var. *diffusa*. A. Gray. Man. 626. 1867. (5 ed.)

Melica altissima Walt. Fl. Car. 78. 1788. Not. L. 1753.



FIG. 169. *Melica diffusa*—a, spikelet; b, flowering glume; c, palea. (Charlotte M. King.)

DESCRIPTION.

TALL MELIC GRASS. Culms $1\frac{1}{2}$ to 4 feet (3-8 dm.) tall, erect, simple, smooth and glabrous. Sheaths shorter than the internodes, the

lower often overlapping; ligule 1 to 2 lines (2-4 mm.) long; leaves 4 to 7 inches (8-14 cm.) long, 2 to 4 lines (4-8 mm.) wide, rough; panicle $6\frac{1}{2}$ to $8\frac{1}{2}$ inches (13-17 cm.) in length, open, the branches spreading or ascending, the lower $1\frac{1}{2}$ to 3 inches (3-6 cm.) long; spikelets usually numerous, about three-flowered, $4\frac{1}{2}$ to $5\frac{1}{2}$ lines (9-11 mm.) long, nodding, on slender, more or less flexuose, pubescent pedicels; empty, basal scales very broad, obtuse or acutish, the first shorter than the second, which is generally much exceeded by the spikelet; flowering scales $3\frac{1}{2}$ to $4\frac{1}{2}$ lines (7-11 mm.) long, acute or obtuse, scabrous. **May to June.**

DISTRIBUTION.

Iowa. Ames, 33 (Ball, Bessey); Mt. Pleasant, 868 (Mills); Johnson County (Shimek); Iowa City (Hitchcock); Jasper County (Preston).

North America. From Pennsylvania, Ohio (Columbus, Sullivan), to Virginia; west to southeastern Iowa, Missouri (Jefferson Barracks, Pammel), Kentucky and Texas (Coleman County, Pammel, Reverchon).

2. MELICA PARVIFLORA.

Melica parviflora Scrib. Mem. Torr. Bot. Club. 5: 50. 1895.

Melica parviflora (Porter.) Scribn. Beal. Grasses of N. A. 2: 502. 1896. Nash in Britton and Brown. Ill. Fl. 1: 195. f. 447. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 264. f. 258. 1900, (3 ed.)

DESCRIPTION.

SMALL FLOWERED MELIC. A rather slender, erect, smooth perennial, $1\frac{1}{2}$ to $2\frac{1}{2}$ feet (4-7 dm.) high, with flat leaves and narrow panicles, 6 to 10 inches (15-25 cm.) long. Sheaths short, overlapping, scabrous; ligule 1 line (2 mm.) long; leaf-blades 5 to 9 inches (12-23 cm.) long, 1 to 2 lines (2-4 mm.) wide, scabrous. Spikelets pendulous and racemose along the panicle branches, 4 to 5 flowered, 5 to 6 lines (10-13 mm.) long; empty glumes obtuse, the first shorter than the second; flowering glumes $3\frac{1}{2}$ to 4 lines (7-8 mm.) long, acutish, scabrous. Shaded canyons. July to September.



*FIG. 170. *Melica parviflora*—a, spikelet; b, empty glumes. (Div. Agros. U. S. Dept. Agrl.)

DISTRIBUTION.

Iowa. Iowa City (Hitchcock, Shimek).

North America. Shaded canyons, mountains of Colorado, New Mexico, Arizona, and prairies of southern Iowa, Missouri, Kansas and western Texas.

3. MELICA MUTICA.

Melica mutica Walt. Fl. Car. 78. 1788. Watson and Coulter. Gray. Man. Bot. 662. pl. 10. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 101. f. 136. 1894. Bull. U. S. Dept. Agr. Div. Agros. 7: 263. f. 257. 1900. (3 ed.) Beal. Grasses of N. A. 2: 505. 1896. Nash in Britton and Brown. Ill. Fl. 1: 195. f. 440. 1896.

Melica mutica var. *glabra* A. Gray. Man. 626. 1867. (5 ed.)

DESCRIPTION.

NARROW MELIC GRASS. A smooth, slender, erect grass, 1 to 3 feet (2-6 dm.) high, with narrow leaves, and nodding spikelets in nearly simple panicles. Panicle few-flowered, sparingly branched below, often reduced to a simple raceme. Spikelets 4 to 5 lines (8-10



FIG. 171. *Melica nutica*—a, spikelet; b, palea, c, anthers. (Div. Agros. U. S. Dept. of Agrl.)



FIG. 172. *Uniola latifolia*—a, spikelet; empty glumes; c, flowering glumes; d, palea. (Div. Agros. U. S. Dept. Agrl.)

mm.) long, with two perfect flowers; empty glumes thin and membranaceous, subequal, about as long as the spikelet. In rich soil. June, July.

Melic grass occurs along our streams as far north as Story County.

DISTRIBUTION.

Iowa. Winneshiek County (Fitzpatrick); New Albin, 933, Iowa-Minnesota line (Pammel); Marshalltown, 263 (R. B. Eckles); Steamboat Rock, 2027 (Pammel).

North America. Occurs from Pennsylvania to Virginia, District of Columbia (Washington, McLain, Vasey; Washington, Hamilton Hill, Ball), to Alabama and Florida; westward to Wisconsin, Minnesota (Houston County, Pammel), Iowa, Missouri (Pilot Knob, Valley Park, Crystal City, Pammel), to Texas.

10. UNIOLA.

Uniola L. Sp. Pl. 71. 1753. Benth and Hooker. Gen. Pl. 3: 1192. Scribn. Bull. U. S. Dept. Agr. Div. Agros. 20: 142. f. 111. (Rev. Ed.)

Spikelets three to many-flowered; rachilla articulated above the empty glumes and between the florets. Empty glumes at the base of the spikelet 3 to 8, compressed-keeled, acute, or acuminate-pointed, striate, many-nerved. Grain compressed, oblong, free. Palea rigid, two-keeled. Stamens 1 to 3. Styles distinct; stigmas plumose. Erect plants, with simple culms, broad, and flat or narrow, and involute leaves, and narrow and few-flowered, or ample, lax and many-flowered panicles.

There are five species, mostly in North America; one native to Central America; one native to the Andes of South America.

1. UNIOLA LATIFOLIA.

Uniola latifolia Michx. Fl. Bor. Am. 1: 70. 1803. Watson and Coulter. Gray. Man. Bot. 663. 1890. (6 ed.) Scribn. Grasses of Tenn. Univ. Tenn. 7: 102. pl. 35. f. 139. Bull. U. S. Dept. Agr. Div. Agros. 7: 270. f. 264. Bull. U. S. Dept. Agr. Div. Agros. 20: 142. f. 111. 1900. Beal. Grasses N. A. 2: 516. f. 105. Nash in Britton and Brown. Ill. Fl. 1: 197. f. 452.

DESCRIPTION.

BROAD LEAFED SPIKE GRASS. An erect grass, with rather stout, simple culms, 2 to 5 feet (6-15 dm.) high, broad, spreading leaf-blades, and a drooping panicle of large, flat spikelets, $\frac{3}{4}$ to $1\frac{1}{4}$ inches (2-3 cm.) long, on capillary pedicels; empty glumes much smaller than the floral ones, which are $4\frac{1}{2}$ to 6 lines (9-12 mm.) long, ciliate-hispid on the winged keel. Sheaths shorter than the internodes; ligule $\frac{1}{2}$ line (1 mm.) long, lacerate-toothed; leaf-blades 4 to 9 inches (10-22 cm.) long, $\frac{1}{4}$ to

1 inch (0.5-2 cm.) wide, narrowed to a rounded, often ciliate base, acuminate at the apex, scabrous on the margins, otherwise smooth. See figure 172 on page 246.

DISTRIBUTION.

Iowa. Not native to Iowa as far as known, though sometimes cultivated in this state.

North America. It is common through central Missouri. Occurs from Pennsylvania to Florida, west to Illinois, Kansas, Missouri and Texas.

11. DACTYLIS.

Dactylis L. Sp. Pl. 71. 1753. Endlicher. Gen. Pl. 100. Beauv. Agros. 85. Bentham and Hooker. Gen. Pl. 3: 1193. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 72. f. 84. Scribner. Bull U. S. Dept. Agr. Div. Agros. 20: 145.

Spikelets several-flowered, crowded in one-sided clusters, forming a branching, dense panicle. Glumes all herbaceous, keeled, awn-pointed, rough-ciliate on the keel; the flowering one five-nerved, the upper most commonly smaller and thinner. Stamens 3. Grain lance-oblong, acute, free. Stout, tufted perennial; leaves keeled. (*Dactylos*, a name in Pliny for a grass with digitate spikes, from the Greek word for *finger*.)

Species 1, with several varieties; very common from Great Britain across the continent; temperate regions of Asia and northern Africa; generally cultivated in North America and Europe.

1. DACTYLIS GLOMERATA.

Dactylis glomerata. L. Sp. Pl. 71. 1753. Watson and Coulter. Gray. Man. Bot. 663. pl. 10. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 104. f. 140. 1896. Beal. Grasses of N. A. 2: 523. 1896. Nash in Britton and Brown. Ill. Fl. 1: 200. f. 457. 18: 6. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 275. f. 269. 1900. (3 ed.)

DESCRIPTION.

ORCHARD GRASS. A coarse, erect grass, 3 to 4 feet (7-9 dm.) high, forming dense tufts. Ligule elongated, membranaceous. Leaves flat, slightly keeled, spreading. Panicle 3 to 8 inches (7-9 cm.) long, the branches spreading in flower, becoming erect and appressed to the rachis. Spikelets compressed, three to five-flowered, crowded at the ends of the branches in dense one-sided clusters. Flowering glumes 2

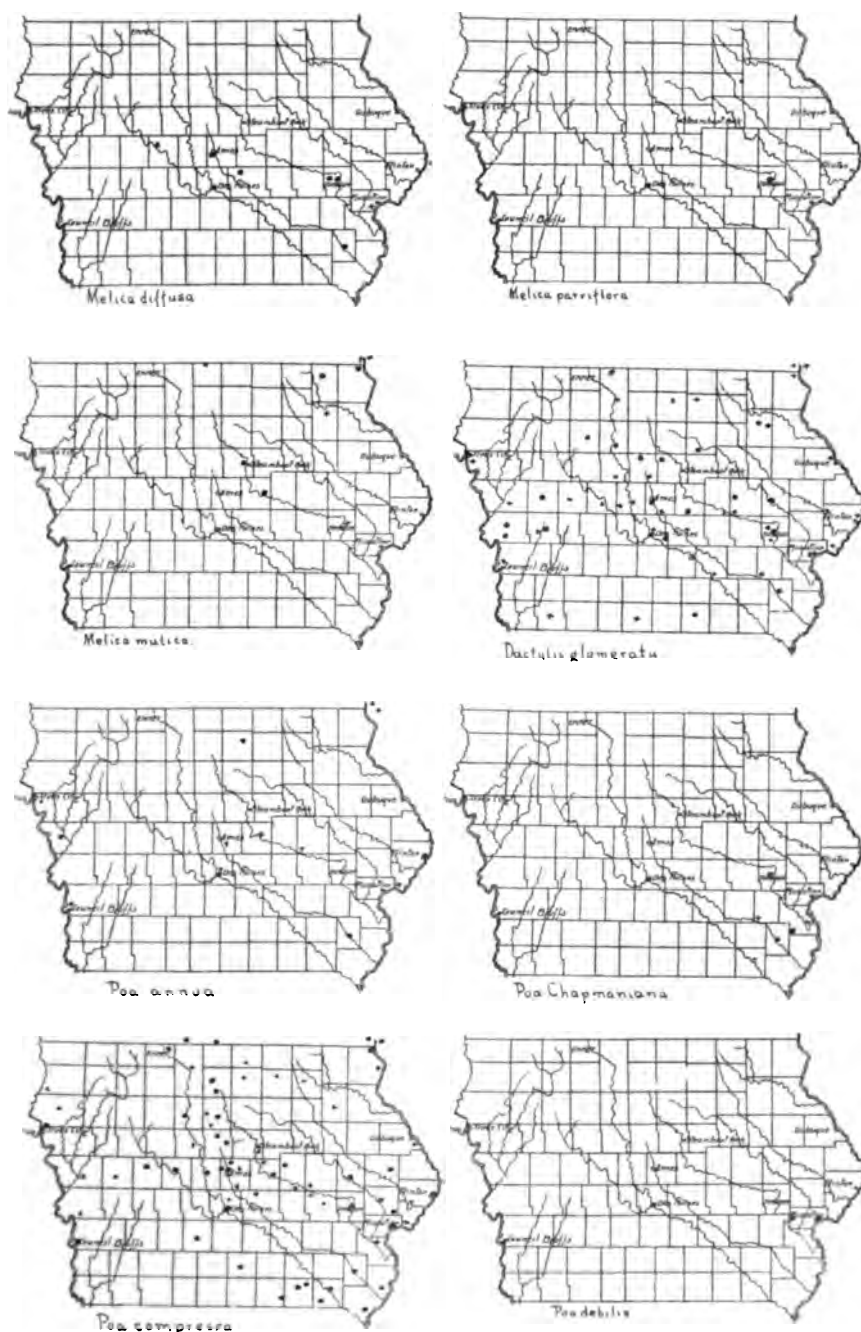


FIG. 178. Distribution of *Melica*, *Dactylis* and *Poa*. *Specimens in herbarium. + Localities observed.

to 3 lines (4-6 mm.) long, lanceolate, very acute or short awn-pointed, ciliate on the keel above. May to August. Fields and waste grounds.

Orchard grass is widely naturalized in the state. It is an excellent forage plant.



FIG. 174. *Dactylis glomerata*—a, spikelet in flower; b, single floret; c, flower with three stamens and two plumose stigmas; d, ligule; e, section of culm at one of the nodes. (Div. Agros. U. S. Dept. Agri.)



FIG. 175. *Briza media*—a, spikelet; b, flower ing glume; c, palea. (Div. Agros. U. S. Dept. Agri.)

DISTRIBUTION.

Iowa. Mitchellville 3185 (Fields); Shelby County, Decatur County (Fitzpatrick); Denison (McHenry); Keystone (Koch); Iowa City (Hitchcock); Sioux City (Miss Wakefield); Parkersburg 632 (Stout); Mt. Pleasant (Mills); Van Cleve (Warden); West Union, 1433 (Whitmore); Ames 132 (Ball, Beardslee, Hitchcock, Bessey, Thurber, Van Houten, P. H. Rolfs, Carver, C. A. Wilson 1093,

Weaver, 1159 Pammel); Johnson County (Shimek); Webster City, 671, Missouri Valley, Logan (Pammel); Fayette (Fink); Alden 1168 (Stevens); Cedar Rapids (Shimek); Calhoun County (Rigg).

North America. Fields and waste grounds, New Brunswick, Connecticut (Hartford County, F. Wilson), Massachusetts (Reedville, Pammel), Michigan, (Grand Rapids, Crozier), Wisconsin (La Crosse, Pammel), Missouri (Eggert), Nebraska (McCook, Pammel, 402); west to Idaho and Colorado (Denver and Golden, Pammel).

General. Common in British Islands, France, Germany, north to Norway and east to Russia and Asia.

12. BRIZA.

Briza L. Sp. Pl. 70. 1753. Endlicher. Gen. Pl. 99. Bentham & Hooker. Gen. Pl. 3: 1194. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 72. f. 83. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 144. f. 113. [Rev. Ed.]

Spikelets many-flowered, rounded-ovate, or heart-shaped; rachilla articulated above the empty glumes and between the florets; florets crowded, the uppermost usually imperfect. Glumes membranaceous, with broad, scarious margins, strongly concave, rounded on the back, and more or less ventricose; empty glumes 2, subequal, shorter than the florets; floral glumes 3 to many-nerved, cordate at the base, awnless; palea much smaller than its glume, obtuse, 2-keeled. Stamens 3. Styles short, distinct; stigmas plumose. Annuals or perennials, with flat or convolute leaves, loosely-flowered and open, or narrow and spike-like panicles.

There are 12 species of *Briza* native to Europe; also occurring in northern Africa, Asia and South America; one species is naturalized in the eastern states and on the Pacific coast.

1. BRIZA MEDIA.

Briza media L. Sp. Pl. 70. 1753. Watson and Coulter. Gray. Man. Bot. 663. pl. 10. (6 ed.) Nash in Britton and Brown. Ill. Fl. 1: 199. f. 455. Beal. Grasses N. A. 2: 520. Scribner. Grasses of Tenn. 7: 103. Bull. U. S. Dept. Agr. Div. Agros. 7: 274. f. 268. (3 ed.)

DESCRIPTION.

QUAKING GRASS. A slender, erect perennial, $\frac{1}{2}$ to 2 feet (1.5-6 dm.) high, with rather short, flat leaf blades, and capillary, spreading panicles, $1\frac{1}{2}$ to 5 inches (4-12 cm.) long. Sheaths shorter than the in-

ternodes; ligule $\frac{1}{2}$ line (1 mm.) long or less; leaf blades 1 to 3 inches (2-8 cm.) long; 1 to $2\frac{1}{2}$ lines (2-5 mm.) wide. Spikelets 2 to $2\frac{1}{2}$ lines (4-5 mm.) long, 5 to 12-flowered, orbicular to deltoid ovate; empty glumes 1 line (2 mm.) long; flowering glumes 1 to $1\frac{1}{2}$ lines (2-3 mm.) long, scarious margined. May to July. See figure 175 on page 250.

DISTRIBUTION.

Iowa. Occasionally cultivated.

North America. In fields and waste places from Ontario to Massachusetts and Rhode Island.

General. Great Britain, central Europe, Siberia and western Asia.

13. POA.

Poa L. Sp. Pl. 1753. Endlicher. Gen. Pl. 98. Bentham & Hooker. Gen. Pl; 3: 1196. Hackel in Engler & Prantl. Nat. Pflanz. Fam. II. 2: 73. f. 85. Beauv. Agros. 70. pl. 14. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 148. f. 117. [Rev. Ed.]. Kunth. Rev. Gram. 150. pl. 83. Steud. Syn. Pl. Glum. 1: 249.

Pseudopoa Koch. Linn. 21: 409.

Leucopoa Griseb. Ledeb. Fl. Ross. 4: 383. 1853.

Poidium Nees. Lindl. Introd. Nat. Syst. 450. 1835. (2 ed.)

Dioicopoa E. Desv. in C. Gay. Fl. Chil. 6: 413.

Spikelets ovate or lance-ovate, laterally compressed, several (2-10) flowered, in an open panicle. Empty glumes mostly shorter than the flowers, the lower smaller; flowering glume membranaceo-herbaceous, with a delicate, scarious margin, compressed-keeled, pointless, 5-nerved (the intermediate nerves more obscure or obsolete) the principal nerves commonly clothed with soft hairs at and toward the often cobwebby base; palea membranaceous, two-toothed. Stamens 2 or 3. Stigmas simply plumose. Grain oblong, free. Culms tufted, from perennial roots; leaves smooth, usually flat and soft. (From the Greek name for grass or fodder.)

Bentham & Hooker give the number of species at 80; Hackel recognizes 100; Beal lists 43 species and 8 varieties; Heller gives 94 species and varieties. Some authors have extended the number to 200; there can be no doubt that conservative botanists will reduce the number of species given for North America. The genus is widely diffused over the temperate and cool regions in both hemispheres. They are also common in Alpine and Arctic regions; there are very few representatives in the tropics. They are excellent forage plants.

Culms low and tufted, spreading, annual or biennial.
 Flowering glume 5-nerved, not webby at the base.....*P. annua*. ¹
 Flowering glumes 3-nerved, or obscurely 5-nerved, webby at the base
 —*P. Chapmaniana*. ²
 Culms low, geniculate-ascending, from a creeping rootstock, much flattened;
 panicle simple and contracted *P. compressa*. ³
 Culms tall, terete, tufted, perennial.
 Flowering glumes 3 mm. or less long, web at base much shorter.
 Flowering glumes glabrous except for the web at base...*P. debilis*. ⁴
 Flowering glumes pubescent on the midnerve only....*P. trivialis*. ⁵
 Flowering glumes pubescent on the midnerve and marginal nerves,
 at least on the lower half.
 Flowering glume silky villous, long web at base...*P. Wolfii*. ⁶
 Intermediate nerves obscure or wanting.
 Culm usually 4 dm. or less tall, the panicle usually less
 than 1.5 dm. long *P. nemoralis*. ⁷
 Culm usually 6-10 dm. tall, panicle elongated, usually 2-4
 dm. long.....*P. flava*. ⁸
 Intermediate nerves prominent.....*P. pratensis*. ⁹
 Flowering glumes 4-5 mm. long, web at base long and copious, exceed-
 ing the scale.....*P. arachnifera*. ¹⁰

Poa annua L. Sp. Pl. 68. 1753. Watson and Coulter. Gray. Man. Bot. 664. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 106. f. 141. 1894. Beal. Grasses of N. A. 2: 530. 1896. Nash in Britton and Brown. Ill. Fl. 1: 201. f. 459. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 237. f. 533. 1899.

LOW SPEAR GRASS. ANNUAL MEADOW GRASS. A low, spreading annual, the erect or ascending, somewhat flattened stems 2 to 12 inches (4-24 cm.) high. Sheaths smooth, lax; leaf-blade flat, smooth, spreading, 1 to 1½ lines (2-3 mm.) wide, 1 to 3 inches (2-6 cm.) long. Panicle short, pyramidal, the primary branches spreading, solitary or in pairs. Spikelets ovate or oblong, three to six-flowered, about 2 lines (4 mm.) long; empty glumes somewhat unequal, the first one-nerved, the second three-nerved; flowering glumes about 1 line (2 mm.) long, distinctly five-nerved, all the nerves more or less hairy below, the base of the flowering glume pilose. Palea two-keeled, keels hairy. May to September.

Poa annua occurs only in cities. Especially in eastern Iowa. Found along the river as far north as Clinton and Mason City. It has been found in Iowa chiefly in shady lawns, and near buildings.

DISTRIBUTION.

Iowa. Clinton, 246 (Pammel); Mt. Pleasant (Mills); Mason City (Pammel).

North America. Fields and waste places, dooryards, etc., throughout the United States and British America. New Jersey (Middletown, Halsted), Wisconsin (Madison, Pammel; Viroqua, H. A., Pam-



FIG. 176. *Poa annua*—a, spikelet; b, floret. (Div. Agros. U. S. Dept. Agrl.)

mel), Missouri (St. Louis, Pammel), Colorado (Ouray, Shear 1149), Utah (Ogden, Pammel 46), Wyoming (Mud Creek, Pammel 928), Vancouver Island (J. McCoun).

General. Great Britain, northern temperate and Arctic Europe, Asia, North Africa.

2. POA CHAPMANIANA.

Poa Chapmaniana Scribn. Bull. Torr. Bot. Club. 21: 38. 1894. Beal. Grasses of N. A. 2: 545. 1896. Nash in Britton and Brown. Ill. Fl. 1: 202. f. 460. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 277 f. 271. 1900. (3 ed.)

Poa cristata Chapm. Fl. S. States. 562. 1860.

DESCRIPTION.

CHAPMAN'S SPEAR GRASS. A low, caespitose annual, 4 to 8 inches (1-2 dm.) high, with ascending, flat leaves, and usually narrow panicles, 1 to 3 inches (2-8 cm.) long. Sheaths close, mostly at the base of the culm; ligule $\frac{1}{2}$ line (1 mm.) long, truncate; leaf-blades $\frac{1}{2}$ to 1 inch (1-2 cm.) long, $\frac{1}{2}$ line (1 mm.) wide or less, smooth. Spikelets three to seven-flowered, $1\frac{1}{4}$ to $1\frac{1}{2}$ lines (2 $\frac{1}{2}$ -3 mm.) long; empty glumes about equal, three-nerved, acute; flowering glumes webbed at the base, obtuse, three-nerved, sometimes obscurely five-nerved, the prominent nerves sometimes pilose for three-fourths of their length, the keel with a prominent, crest-like fringe. Dry, sandy soil. May to June.

Poa Chapmaniana occurs in southeastern Iowa, especially in flood plains of streams. See figure 177 on page 256.

DISTRIBUTION.

Iowa. Morning Sun (Carver); 1357, Ottumwa (Pammel); Iowa City (Hitchcock).

North America. Dry, sandy soil, southern Illinois, to Mississippi and Georgia.

3. POA COMPRESSA.

Poa compressa L. Sp. Pl. 69. 1753. Watson and Coulter. Gray. Man. Bot. 664. pl. 10. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 107. f. 143. 1894. Bull. U. S. Dept. Agr. Div. Agros. 17: 248. f. 544. 1899. Beal. Grasses of N. A. 2: 546. 1896. Nash in Britton and Brown. Ill. Fl. 1: 202. f. 461. 1896.

DESCRIPTION.

WIRE GRASS. A slender, but rather rigid, perennial with much flattened stems, 6 to 20 inches (12-40 cm.) high, ascending from a more or less creeping base, and usually small, narrow panicles. Leaves about 1 line (2 mm.) long, abruptly pointed at the tip; ligule $\frac{1}{2}$ line (1 mm.) long. Panicle expanded, or more often contracted, 1 to 3 inches (2-6

cm.) long, the equal, primary branches in pairs; pedicels shorter than the spikelets. Spikelets lanceolate, five to nine-flowered, 2 to 3 lines (4-6 mm.) long; flowering glumes about $1\frac{1}{2}$ lines (3 mm.) long, obscurely five-nerved, with narrow, scarious margins, the keel and lateral



FIG. 177. *Poa Chapmantana*—a, b, spikelets; c, flowering glumes. (Div. Agros. U. S. Dept. Agrl.)



FIG. 178. *Poa compressa*—a, spikelets; b, flowering glumes, c, cross section of culm; d, section of leaf. (Div. Agros. U. S. Dept. Agrl.)

nerves smooth, or silky haired below. Palea two-nerved, nerves scabrous. Dry meadows and waste places. June to September.

Poa compressa is extensively naturalized in most parts of Iowa, especially eastern, central, southern and northeastern Iowa. A valuable forage plant, yielding, however, less than bluegrass.

DISTRIBUTION.

Iowa. Baxter (Williamson); 875, 856 and 1172, Mt. Pleasant (Mills); Armstrong (Cratty); 1138, Durant (Weaver); Ames (Sirriner, Hitchcock, 152, Ball, E. R. Wilson, Rich and Gossard, C. A. Wilson, Bessey, Fisher, Crozier, Carver, Stewart); Sioux City, Clinton, Des Moines, Dakota City, 3191 Moulton, 1927 New Albin, Webster City, 1454 De Witt, 1427 Carroll, 906 Elmore, Minn., Iowa-Minnesota line, Jefferson, Marshalltown, Russell, Cedar Rapids, 786 Marshalltown, 1244 Council Bluffs (Pammel); Gilbert, Jewell Junction, Boone to Winterset (Carver); Chariton (Bennett); Lebanon (Sample); Mt. Zion (Moore); 22 Lebanon (Ball and Sample); 3276 Ontario (Faurot); Chariton 676 (Mallory); 826 Belknap (Rankin); Marshalltown (Eckles); Muscatine (Reppert); Tipton, Iowa City (Hitchcock); Keystone (Koch); Keokuk and Lee County (Shimek); Hamilton to Hancock County (Preston), Onslow (Cameron); Hancock County, Unionville (Shimek); Decatur County (Shimek).

North America. Dry meadows and waste places, Newfoundland to New York (Parry), to South Carolina, Tennessee and westward; Illinois (Ogle County, Edwards), Missouri (St. Louis, Eggert; Webster, Pammel), Nebraska (northeastern Nebraska, Clements, 2643; Grand Island, 115; McCook, 397, 403, Crete, 205, Pammel), North Dakota (Richburg, Condit), California (Mt. Shasta, Palmer, 2654).

General. Great Britain, middle and southern Europe, Siberia, Kamchatka.

4. POA DEBILIS.

Poa debilis Torr. Fl. N. Y. 2: 459. 1843. Watson and Coulter. Gray. Man. Bot. 665. 1890. (6th ed.) Beal. Grasses of N. Am. 2: 539. 1896. Nash in Britton and Brown. Ill. Fl. 1: 206. f. 472. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 239. f. 535. 1899.

DESCRIPTION.

WEAK SPEAR GRASS. A slender, erect, smooth perennial, $1\frac{1}{2}$ to 2 feet (3-7 dm.) high, with rather short, flat leaves, and nodding, few-flowered, open panicles, 2 to 6 inches (4-12 cm.) long, spikelets $1\frac{1}{2}$ to 2 lines (3-4 mm.) long, two to four-flowered, with unequal, acute empty glumes, broadly obtuse and scarious-tipped flowering glumes conspicuously webbed at the base. In rocky woodlands. May to July.

Poa debilis has been found at one locality only in Muscatine County, Iowa. See figure 179, on page 258.

DISTRIBUTION.

Iowa. Blue Grass (Barnes); Wild Cat Den (Reppert).

North America. Nova Scotia and New Brunswick, southward to Vermont (Charlotte, Pringle), Pennsylvania and westward to Minnesota (Itaska Lake, Sandberg).

5. POA TRIVIALIS.

Poa trivialis L. Sp. Pl. 67. 1753. Watson and Coulter. Gray. Man. Bot. 665. (6th ed) 1890. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 108. f. 145. 1894. Bull. U. S. Dept. Agr. Div. Agros. 17: 243. f. 539. 1899. Beal. Grasses of N. A. 2: 531. 1896. Nash in Britton and Brown. Ill. Fl. 1: 204. f. 468. 1896.



FIG. 179. *Poa debilis*—a, empty glumes; b, flowering glumes. (Div. Agros. U. S. Dept. Agr.)



FIG. 180. *Poa trivialis*—a, empty glumes; b, flowering glumes. (Div. Agros. U. S. Dept. Agr.)

DESCRIPTION.

ROUGH STALKED MEADOW GRASS. An erect perennial, 1 to 3 feet (2-7 dm.) high, with flat leaves, open panicle, and no conspicuous rootstock. Culm rough or scabrous near the summit, not flattened. Sheaths a little scabrous; ligule 2 to 3 lines (4-6 mm.) long; leaf-blade 3 to 6 inches (6-12 cm.) long, about 2 lines (4 mm.) wide, acute. Panicle narrowly pyramidal, 3 to 8 inches (6-16 cm.) long. Spikelets ovate, usually two-flowered. Empty glumes strongly keeled, very acute, the lower one-nerved, the upper broader and three-nerved; flowering glume ovate-lanceolate, strongly five-nerved, fringed on the keel with silky hairs, otherwise smooth. Palea smooth. Meadows and roadsides. June to August.

Poa trivialis occurs in southeastern Iowa as far north as Ames. The Ames and Cordova localities indicate that the grass is native. It is usually regarded as a native of Europe.

DISTRIBUTION.

Iowa. Sedan 3380, Ames 938 (Pammel); Ames 668 (Pammel and Combs).

North America. Meadows and roadsides through eastern, southern and northern United States; Ohio (Columbus, Sullivant; Lancaster, Dr. Bigelow), Wisconsin (La Crosse, Pammel); Lineville, Centerville (Shimek).

General. Great Britain, Germany to North Africa, Siberia, Dahuria.

6. POA WOLFII.

Poa Wolfii Scribner. Bull. Torr. Bot. Club. 21: 228. 1894. Bull. Univ. Tenn. Agrl. Ex. Sta. 7: 110. *pl.* 38. *f.* 149. 1894. Britton and Brown. Ill. Fl. 1: 207. *f.* 476. Britton Man. 140.

P. Wolfii (Vasey) Scribner. Beal. Grasses of N. A. 2: 553. (2d ed.)

Pammel and Scribner. Proc. Soc. Prom. Agrl. Sci. 17: 102. Contr. I.S. C. Bot. Dept. 3.

DESCRIPTION.

WOLF'S MEADOW GRASS. A slender perennial, one to three feet high, with a loose, nodding panicle. Sheaths rather loose, mostly shorter than the internodes, the lower scarious; ligule one-half a line long; leaf-blade three to six inches long, one to two lines wide. Panicle slender, lax, three to six inches long, primary branches two to three, rarely

more, at each node of the main rachis. Spikelets ovate, two to three lines long, three to five-flowered; empty glumes nearly equal, three-nerved; flowering glumes strongly keeled, lanceolate, five-nerved, silky-villous along the margins and keels and with a copious long web at the base. Keels of the palea villous. This grass has been confounded with *P. alsodes* and *P. autumnalis*. It is closely related to the latter, but both



FIG. 181. *Poa Wolfti*—a, spikelet; b, flowering glume; c, palea. (Charlotte M. King.)

empty glumes are three-nerved, the flowering glumes are more acute and have a tuft of long, webby hairs at the base.

DISTRIBUTION.

Iowa. Only found in northeastern Iowa, Allamakee County, banks of Yellow River. Rocks and rocky woods (L. H. Pammel, E. Orr.

D. O. Wilson), associated with *Abies balsamea*, *Pyrus orbatifolia* and *Betula papyrifera*.

General. Tennessee to Kansas, Illinois and Iowa.

7. POA NEMORALIS.

Poa nemoralis L. Sp. Pl. 69. 1753. Watson and Coulter. Gray. Man. Bot. 664. 1890. (6th ed.) Beal. Grasses of N. A. 2: 552. 1896. Nash in Britton and Brown. Ill. Fl. 1: 205. f. 470. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 250. f. 546. 1899.

Poa caesia var. *strictior* A. Gray. Man. Bot. 629. 1867. (5th ed.)



FIG. 182. *Poa nemoralis*—a, empty glumes; b, flowering glumes; c, palea. (Div. Agros. U. S. Dept. Agr.)

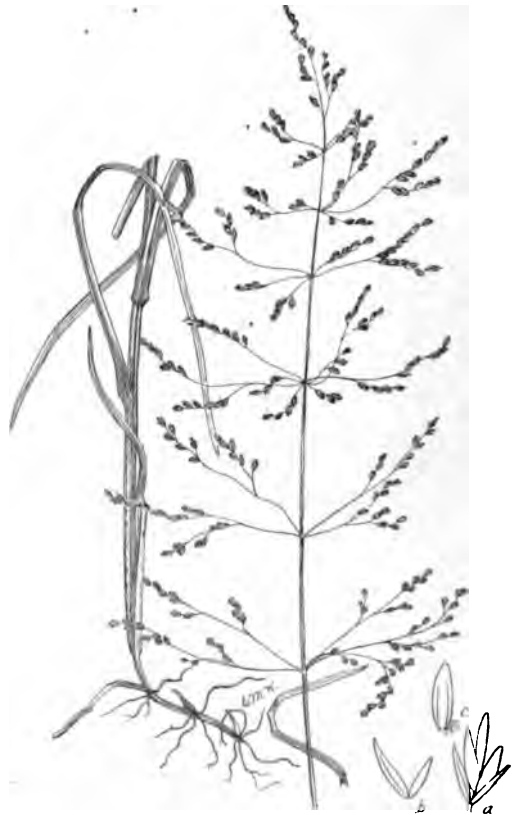


FIG. 183. *Poa flava*—a, spikelet; b, empty glumes; c, flowering glumes. (Charlotte M. King.)

DESCRIPTION.

WOOD MEADOW GRASS. A slender, erect and rather rigid perennial, 1 to $2\frac{1}{2}$ feet ($1\frac{1}{2}$ -6 dm.) high, with narrow, flat leaves, and usually open panicles 2 to 5 inches (4-10 cm.) long. Spikelets two to five-flowered, $1\frac{1}{2}$ to $2\frac{1}{2}$ lines (3-5 cm.) long, with very acute empty glumes and faintly nerved flowering glumes, which are 1 to $1\frac{1}{2}$ lines (2-3 mm.) long, and webbed at the base. Dry or rather moist soil, Labrador and Newfoundland to Pennsylvania, westward to British Columbia, Idaho and Colorado. June to September.

Poa nemoralis has been cultivated in central Iowa, where it persisted for a few years. It is not known to be a native of Iowa, although occurring in the vicinity of La Crosse, Wisconsin, on sandstone rocks.

DISTRIBUTION.

Iowa. Ames, cultivated (Sirrinc, Pammel, Crozier). The species has been found near La Crosse, Wisconsin (Pammel).

North America. Dry or rather moist soil, Labrador and Newfoundland to Pennsylvania, westward to British Columbia, Idaho and Colorado (Cache, La Poudre River 17, Ft. Collins, Colorado Springs, Golden, Rists' Canon, Beaver Creek, Pammel; Larimer County, Crandall; Parry), Wyoming (Williams 2943; Albany County, Nelson, 1885; Yellowstone National Park, A. & E. Nelson; Sheridan County 112, 113, 127; Sherman, 247; New Castle 155, Pammel; Fuller's Ranch, Black Fork, Pammel, Johnson, Buchanan and Lummis), Utah (southern Utah, Parry; Haydens' Fork 153, and Smith's Fork, Pammel and Stanton), New Mexico (Parry, 233), Wisconsin (La Crosse, C. M. King), and Minnesota (Carleton, Sandberg).

General. Great Britain, Germany, Arctic and northern Europe to the Mediterranean Sea, Siberia to the Himalayas.

8. POA FLAVA.

Poa flava L. Sp. Pl. 68. 1753. Beal. Grasses of N.A. 2: 550. 1896. Nash in Britton and Brown. Ill. Fl. 1: 205. f. 471. 1896.

Poa serotina Ehrhart. Beitr. 6: 83. 1791. Watson and Coulter. Gray. Man. Bot. 665. 1890. (6th ed.)

DESCRIPTION.

FOWL MEADOW GRASS. Culms $1\frac{1}{2}$ to 5 feet (4-12 dm.) tall, erect, simple or rarely branched, smooth, glabrous. Sheaths usually shorter than the internodes, smooth and glabrous; ligule 1 to 2 lines (2-4 mm.)

long; leaves 2 to 6 inches (4-12 cm.) long, 1 to 2 lines wide, smooth or rough; panicle 6 to 13 inches (12-26 cm.) in length, open, the branches spreading or ascending, 2 to 5 inches (4-10 cm.) long, divided and spikelet-bearing above the middle; spikelets three to five-flowered, $1\frac{1}{2}$ to 2 lines (3-4 mm.) long; empty glumes acute, glabrous, rough above on the keel, the lower usually 1-nerved, the upper three-nerved; flowering glumes obtuse, somewhat webby at the base, 1 to $1\frac{1}{2}$ lines (2-3 mm.) long, silky-pubescent on the lower half of the marginal nerves and the mid-nerve, the intermediate nerves obscure or wanting. July to August.

Poa flava is common along streams in northern, eastern and central Iowa. A good forage grass. See figure 183, on page 261.

DISTRIBUTION.

Iowa. North Ames (Fawcett); Ceylon 3306, Elmore, Minn., Iowa-Minnesota line 1044, New Albin 898, Ledyard 891, New Albin 1009, Dakota City, Steamboat Rock 2329, Marshalltown, Humboldt, Council Bluffs 1283 (Pammel); Spirit Lake (Shimek); Ames (Zmunt, 4, Ball and Sample, P. H. Rolfs, Sirrine, Pammel and Hodson, Hitchcock, Crozier, Stewart, Beardslee, Weaver); Steamboat Rock 3167 (Miss King); Sioux City (Miss Wakefield); Iowa City (Hitchcock); Emmet County, Armstrong (Cratty); Jewell Junction 912 (Carver); Hamilton County (P. H. Rolfs); Hull (Newell); Le Claire (F. M. Rolfs); Clermont 2078 (Walker); Rock Rapids (Shimek); Marshalltown 285 (Eckles); West Union (Whitmore); Iowa City (Hitchcock and Macbride); Mason City, Hanlontown (Pammel).

North America. In swampy places, Nova Scotia and New Brunswick to Vancouver Island (J. McCoun), south to New York (Parry), New Jersey, Ohio (Painsville, Beardslee), Illinois, Wisconsin (La Crosse, Pammel 3369), Minnesota (Sandberg), South Dakota (Griffith 823), Colorado (Hall and Harbour; Ft. Collins, Crandall; Leadville, Trelease; Ft. Collins and Greeley, Pammel), New Mexico (Las Vegas, Vasey 144), Washington (Ophir, Elmer), Oregon (Howell), Montana (Craig), Arizona (Palmer).

General. Middle and southern Europe to northern Africa and Asia, in Siberia and Asia Minor to the Himalayas.

9. POA PRATENSIS.

Poa pratensis L. Sp. Pl. 67. 1753. Watson and Coulter. Gray. Man. Bot. 665. 1890. (6th ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 108. f. 144. 1894. Bull. U. S. Dept. Agrl. Div. Agros. 7: 279. f. 273. 1900. (3d ed.) Beal. Grasses of N. A. 2: 543. 1896. Nash in Britton and Brown. Ill. Fl. 1: 204. f. 466. 1896.

Poa pratensis var. *angustifolia* Kunth. Enum. 1: 353. 1833.

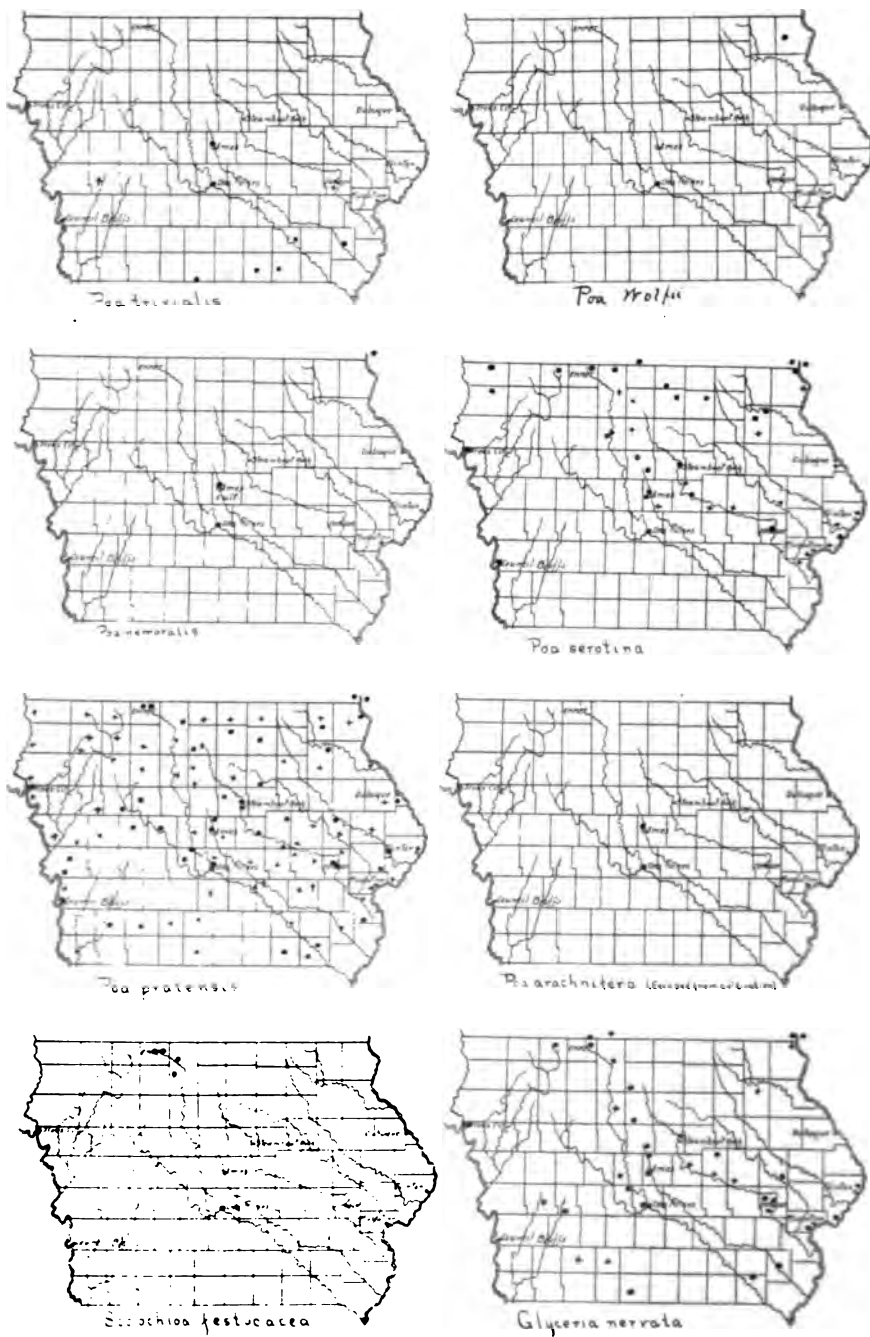


FIG. 184. Distribution of *Poa*, *Scolochloa* and *Glyceria*. *Specimens in herbarium. †Localities observed.

DESCRIPTION.

KENTUCKY BLUE GRASS, JUNE GRASS. An erect perennial, 1 to 3 feet ($2\frac{1}{2}$ -7 dm.) high, with smooth stems, flat leaves, open panicle and extensively creeping rootstocks. Sheaths smooth, ligule about $\frac{1}{2}$ line (1 mm.) long; leaf-blade, 4 to 10 inches (8-20 cm.) long, $\frac{1}{2}$ to 3 lines



FIG. 185. *Poa pratensis*—a, spikelet; b, flowering glume. (Div. Agros. U. S. Dept. Agr.)



FIG. 186. *Poa arachnifera*—a, empty glumes; b, flowering glumes; (Div. Agros. U. S. Dept. Agr.)

(1-6 mm.) wide, apex abruptly pointed. Panicle pyramidal, 3 to 7 inches (6-14 cm.) long, the primary branches usually in threes or fives. Spikelets about 2 lines (4 mm.) long, three to five-flowered, mostly on very short, scabrous pedicels; empty glumes a little unequal, the first narrowly-lanceolate and usually one-nerved, the second broader and

three-nerved, flowering glumes ovate, scarious toward the apex, five-nerved, the nerves silky-hairy below, and with a small tuft of cobwebby hairs at the base. May to July.

Blue grass occurs in all parts of Iowa, but probably only as an introduced plant. The earliest settlers brought the seed with them. The species takes kindly to all kinds of soil except the very low grounds. It is commonly found in woods, and is now displacing the wild prairie grasses in unbroken sod. *Poa pratensis* is the most valuable pasture grass in Iowa. It runs into many varieties.

DISTRIBUTION.

Iowa. Steamboat Rock, Pine Creek (Miss King); 3214 Mason City, 3215 Calmar Junction, 2260 Des Moines, 661 Missouri Valley, 1508 Wall Lake, 2143 Bloomfield, Sioux City, 1025 Story City, Logan, Jefferson, Carroll, Council Bluffs, 661 Missouri Valley, 2124 Wall Lake Pammel); 3162 Lansing, 3195 Steamboat Rock (Miss King); 633 Parkersburg (Stout); Corwith (Pierson); 3297 Red Oak (Miller); 1142 Durant (Weaver); 1121 Alden (Stevens); 2258 Mt. Pleasant (Mills); Morning Sun (Carver); 2075 and 2076 Clermont (Walker); Ames (Stewart, P. H. Rolfs, Fred Rolfs, Sirrine, 1158 Pammel, Beardslee, Fisher, Weaver, Crozier); 2057 Mt. Pleasant (Mills); Mt. Zion (Moore); Sioux City (Miss Wakefield); 1069 Emmet County (Cratty); Marshalltown (Eckles); Fayette (Fink); Wheatland (Ball); Dysart (Miss Sirrine); Monticello (Bessey); Johnson County, High Bridge, Dallas County (Shimek); Iowa City (Macbride, Preston); Emmet County (Cratty); Calhoun County (Rigg); Wall Lake (Pammel); Mahaska County (White); Ft. Dodge (Olson).

North America. Fields and meadows throughout the United States and British America; Massachusetts (Cambridge, Pammel), Illinois (East St. Louis, Eggert), Missouri (St. Louis, Pammel), South Dakota (Brookings, Williams 2227), Nebraska (Hastings 116 and 94, McCook 393, Oxford, Grand Island 69, Pammel), Colorado (Larimer County, Colorado Springs 290 and 264, Stove Prairie Hill, Ft. Collins, Beaver Creek, La Porte, Cache La Poudre River, Pammel), Wyoming (Albany County, A. Nelson; Sherman 244, Pammel; Sheridan County, Pammel and Stanton; Black's Fork, Pammel, Buchanan, Johnson and Lummis, 922 and 1681), Utah (Ft. Douglas, Pammel, John-

son, Buchanan and Lummis; Rhodes Canon, alt. 9800 ft., Pammel and Stanton; Mill Creek 156, Wilson's Peak 158, Pammel and Stanton).

General. Great Britain, Germany to Switzerland and arctic regions of Europe.

10. POA ARACHNIFERA.

Poa arachnifera Torr. Marcy. Exp. Red River La. 301. 1853. Beal. Grasses of N. A. 2: 535. 1896. Scribner. Bull. U. Dept. Agrl. Div. Agros. 17: 246. f. 542. 1899.

Poa arachnifera Buckley. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 110. f. 151. 1894.

DESCRIPTION.

TEXAS BLUE GRASS. A rather strong growing perennial, 1 to 3 feet (2-7 dm.) high, with an extensively creeping root-stock, longleaves, and narrow, densely flowered panicle. Sheaths firm, striate, smooth; ligule about 1 line (2 mm.) long; leaf-blade flat, scabrous on the upper surface, smooth beneath, the lower 6 inches to 2 feet (1-5 dm.) long, the upper 2 to 4 inches (4-8 cm.) long, 1 to 2 lines (2-4 mm.) wide, blunt-pointed at the apex. Spikelets ovate-lanceolate, 2 to 4 lines (4-8 mm.) long, three to seven-flowered; empty glumes unequal, acute, the first one-nerved, the second three-nerved, scabrous on the keels; flowering glumes five-nerved; in the fertile plant the nerves are hairy and there is a very copious tuft of long, cobwebby hairs at the base; in the sterile or staminate plants the flowering glumes are smooth. Palea two-keeled, keels hispid and subaristate-pointed. Staminate and pistillate plants alike, differing only in the wooliness of the flowering glumes. April to June.

Texas blue grass has been cultivated in central Iowa, where it is entirely hardy. The species has persisted for several years. See figure 186, on page 265.

DISTRIBUTION.

Iowa. Ames (Sirriner).

North America. A native of Texas (Buckley); introduced into cultivation in some of the southern states.

14. SCOLOCHLOA.

Scolochloa Link. Hort. Berol. 1: 136. 1827.

Graphephorum Desv. Nouv. Bull. Soc. Philom. 2: 189. 1810. Journ. Bot. 1: 71. 1813. Bentham and Hooker. Gen. Pl. 3: 1197. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 74. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 151. f. 120. (Rev. ed.)

Arundo Endlicher Gen. Pl. 91.

Flumina Fries. Summ. Scand. Veg. 247. 1846.

Spikelets two to four-flowered, subterete. Rachis hairy at the base of the flowers, ending in a naked pedicel. Empty glumes concave, membranaceous, unequal, the outer three-nerved, acute, the inner five-nerved, toothed at the apex, nearly equalling the flowers; flowering glume more rigid, prominently seven-nerved, toothed at the apex; nerves all parallel. Stamens 3. Stigmas plumose. Ovary hairy. Tall perennials, growing in water, with loosely sheathing leaves, and spikelets in a lax panicle. (Name probably from the Greek words for *prickle* and *grass*.)

Bentham & Hooker, as well as Hackel, give the number of species as two; they are found in the north temperate zones of both continents: one species is common to North America, Europe and Asia.

1. SCOLQCHLOA FESTUCACEA.

Scolochloa festucacea Link. Hort. Berol. 1: 137. 1827. Watson and Coulter. Gray. Man. Bot. 666. *pl.* 15. 1890. (6th ed.)

Scolochloa arundinacea (Link.) MacMillan. Beal. Grasses of N. A. 2: 559. *f.* 112. 1896.

Scolochloa festucacea (Willd.) Link. Nash in Britton and Brown. Ill. Fl. 1: 209. *f.* 482. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 271. *f.* 567. 1899.

Arundo festucacea Willd. Enum. 1: 126. 1809.

DESCRIPTION.

FESCUE SCOLOCHLOA. A stout, erect, glabrous perennial, $2\frac{1}{2}$ to 4 feet (9-15 dm.) high, with long, flat leaves, and open panicles, 8 to 15 inches (16-30 cm.) long. Spikelets three to five-flowered, 3 to 4 lines (6-8 mm.) long, with unequal, acute, outer glumes, and seven-nerved, scabrous flowering glumes which have a tuft of hairs at the base. Wet grounds or in shallow water. June to August.

DISTRIBUTION.

Iowa. Gridley 3225 (Pammel); Emmet County, Armstrong 1049 (Cratty); Kossuth County (Pammel).

North America. Wet grounds or in shallow water, Minnesota, Iowa to Nebraska, and northward to Manitoba and Assiniboia.

General. Northern Europe and Siberia.



FIG. 187. *Sclerhloa festucacea*—a, b, spikelets. (Div. Agros. U. S. Dept. Agrl.)



FIG. 188. *Glyceria nervata*—a, b, spikelets; c, d, flowering glumes. (Div. Agros. U. S. Dept. Agrl.)

15. GLYCERIA.

Glyceria R. Br. Prod. 179. 1810. Endlicher. Gen. Pl. 98. Bentham and Hooker. Gen. Pl. 3: 1197. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 74. f. 86.

Panicularia Fabr. Enum. Pl. Hort. Helmst. 373. 1763. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 153. f. 122. [Rev. ed.]

Hydrochloa Hartm. Gram. Scand. 8: 1819.

Porroteranthe Steud. Syn. Glum. 1: 287. 1855.

Spikelets terete or flattish, several to many-flowered; the flowers mostly early deciduous by the breaking up of the rachis into joints, leaving the short and unequal, one to three-nerved, membranaceous, lower glumes behind. Flowering glume and palet naked, of a rather firm texture, nearly equal; the glume rounded on the back, scarious (and sometimes

obscurely toothed) at the blunt or rarely acute summit, glabrous, prominently five to seven-nerved, the nerves parallel and separate. Squamulae fleshy and truncate, or none. Stamens commonly 2. Styles present; stigmas compoundly plumose. Ovary smooth. Grain oblong, free, the furrow very narrow or none. Perennial, smooth, marsh grasses, mostly with creeping bases or root-stocks; spikelets panicle. (Name from the Greek word for *sweet*, in allusion to the taste of the grain.)

Bentham & Hooker give the number of species as 30; reduced, however, by Hackel to 16; several of the included species in Bentham & Hooker are excluded because of their lack of affinity with *Glyceria*. The Section *Atropis* of Bentham & Hooker is excluded by Hackel and the genus *Puccinellia* is placed under *Atropis*. Beal recognizes ten species of *Glyceria* for North America.

KEY TO THE SPECIES OF GLYCERIA.

Spikelets ovate or oblong; panicle open.

Spikelets 2-3 mm. long, branches of the panicle often drooping.

—*G. nervata*.¹.

Spikelets 4-6 mm. long, branches of the panicle erect or ascending.

—*G. Americana*.².

Spikelets linear, 12 mm. long or more, panicle long and narrow.

Flowering glume thick, hispidulous all over, truncate at the apex.

—*G. fluitans*.³.

Flowering glume thin, hispidulous on the nerves only, rounded at the apex *G. borealis*.⁴.

1. GLYCERIA NERVATA.

Glyceria nervata Trin. Mem. Acad. St. Petersburg. VI. 1: 365. 1831.

Watson and Coulter. Gray. Man. Bot. 667. *pl.* 10. 1890. (6 ed.) Scribner.

Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 112. *f.* 153. 1894.

Panicularia nervata Kuntze. Rev. Gen. Pl. 2: 783. 1891.

Panicularia nervata (Willd.) Kuntze. Beal. Grasses of N. A. 2: 567. 1896. Nash in Britton and Brown. Ill. Fl. 1: 212. *f.* 488. 1896.

Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 287. *f.* 281. 1900. (3 ed.)

Poa nervata Willd. Sp. Pl. 1: 389. 1798.

DESCRIPTION.

NERVED MANNA GRASS. A leafy perennial, 1 to 3 feet (2-6 dm.) high, with an expanded, nodding panicle. Sheaths scabrous, ligule 1 to 2 lines (2-4 mm.) long, broadly truncate; leaf-blade 2 to 5 lines (4-10 mm.) wide, 6 to 12 inches (12-24 cm.) long, more or less scabrous above, abruptly acute. Panicle 3 to 12 inches (6-24 cm.) long, usually 4 or 5 inches (8 or 10 cm.), pyramidal, the spreading branches usually

drooping. Spikelets 1 to 2 lines (2-4 cm.) long, three to seven-flowered, obtuse; empty glumes, rather broadly ovate, less than $\frac{1}{2}$ line (1 mm.) long; flowering glumes truncate-obtuse, $\frac{3}{4}$ to 1 line ($1\frac{1}{2}$ to 2 mm.) long, and strongly seven-nerved. Paleas two-toothed. Very variable in size. Wet meadows, marshes, moist thickets etc. June to September. See figure 188, on page 269.

Nerved manna grass is common throughout the state in low meadows, but most abundant in the northern sections. It occurs in considerable abundance in southwestern Iowa, in Fremont and Page counties. It has little agricultural value.

DISTRIBUTION.

Iowa. Nodaway River (Stewart); Ames (Hitchcock, 5 Ball and Sample, Bessey, 6 and 7 Beardslee, Crozier, 175 Ball, P. H. Rolfs, Stewart, C. A. Wilson, Pammel, 14 Ball); 6 Elmore, Minn., Minnesota-Iowa line, 1310 Council Bluffs, 3363 and 3364 Spirit Lake, 2255 Des Moines (Pammel); Jewell Junction (Carver); Mt. Pleasant 867 (Mills); Tama County (Sirriner); Iowa City (Hitchcock); Johnson County (Shimek); Armstrong (Cratty); Story City 777 and 1024 (Pammel and Beyer); Decatur County (Fitzpatrick); Sioux City (Miss Wakefield); Birmingham 940 (Pammel); High Bridge, Dallas County (Shimek); Hamilton to Hancock County (Preston); Ogden (Pammel); Ft. Dodge (Oleson).

North America. Wet meadows, marshes, moist thickets, etc., Newfoundland, New York (Parry), Massachusetts (Pammel), south to Florida, Wisconsin (La Crosse, Pammel), Illinois (Redbud, Pammel), Minnesota (Itaska Lake, Sandberg), Nebraska (Savage, Reece), Missouri (St. Louis, Forest Park, Eggert; Washington, Pammel; 8979 Nelson), Colorado (Larimer County, Crandall), Wyoming (Sheridan, Pammel; Black's Fork, Pammel, Johnson, Buchanan and Lummis; New Castle and Sherman, Pammel), Idaho (Sandberg, Heller and McDougal), Utah (Parry and Palmer).

General. Introduced in France.

2. GLYCERIA AMERICANA.

Glyceria Americana Pammel *nov. comb.*

Poa aquatica var. *Americana* Torr. Fl. U. S. 1: 408. 1824.

Glyceria grandis S. Wats. A. Gray. Man. Bot. 667. 1890. (6 ed.)

Glyceria aquatica Smith. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 112. f. 152. 1894.

Panicularia Americana (Torr.) MacM. Met. Minn. Val. 81. 1892. Beal. Grasses of N. A. 2: 568. f. 114. 1896. Nash in Britton and Brown. Ill. Fl. 1: 212. f. 489. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 286. f. 280. 1900. (3 ed.)

DESCRIPTION.

REED MEADOW GRASS. A stout perennial, 3 to 5 feet (6-10 dm.) high, with an ample, open panicle, and rather broad, flat leaves. Sheaths mostly smooth, and closed nearly to the top; ligule about 1 line (2 mm.) long; leaf-blade 3 to 6 lines (6-12 mm.) wide, 10 to 20 inches (20-40 cm.) long, smooth on the lower surface, scabrous above. Panicle oblong-pyramidal, 8 to 16 inches (16-32 cm.) long, branches finally widely spreading. Spikelets narrowly oblong, five to seven-flowered, usually purplish; $1\frac{1}{2}$ to 3 lines (3-6 mm.) long, empty glumes ovate-lanceolate, obtuse or acute, slightly unequal, the second the larger, about 1 line (2 mm.) long; flowering glume ovate, obtuse; about 1 line (2 mm.) long, strongly seven-nerved. Paleas two-toothed, about equaling their glumes. Shaded banks of streams, wet meadows, moist thickets, etc. June to August. See figure 188, on page 274.

Reed meadow grass is common in the lake region of northern Iowa, and along the borders of streams in eastern and central Iowa.

DISTRIBUTION.

Iowa. Battle Creek 1029 (Preston); 1921 Elmore, Ledyard, 3359 Spirit Lake, 3222 Gridley, 3177 between Armstrong and Gridley (Pammel); Algona (Hitchcock); 3273 Robertson (Hunt); Ames (Sirriner); 3 Ames (Ball and Sample); 1464 West Union (Whitmore); 5 near Forest City (Shimek); 1115 Armstrong (Cratty); Winneshiek County (Bartsch and Fitzpatrick); 3310 Ceylon (Pammel); Hamilton to Hancock County (Preston).

North America. New Brunswick to Alaska, south to Massachusetts (Brookline, Pammel), New York (Parry), Pennsylvania, Tennessee, Wisconsin (La Crosse 3299 and 3232, Bloomingdale, Pammel), Minnesota (1228 Sandberg), Dakota (Valley City, Craig), Nebraska, New Mexico, southern California, Colorado (629 Hall and Harbour; Larimer County, Crandall), Wyoming (Williams; Black's Fork, Pammel and Johnson; Sherman and New Castle, 146 A. Pammel).

3. GLYCERIA FLUITANS.

Glyceria fluitans R. Br. Prod. Fl. Nov. Holl. 1: 179. 1810. Watson and Coulter. Gray. Man. Bot. 667. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 113. *f.* 156. 1894.

Panicularia fluitans Kuntze. Rev. Gen. Pl. 782. 1891.

Panicularia fluitans (L.) Kuntze. Beal. Grasses of N. A. 2: 569. 1896. Nash in Britton and Brown. Ill. Fl. 1: 213. *f.* 497. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 291. *f.* 285. 1900. (3 ed.)

Festuca fluitans L. Sp. Pl. 75. 1753.

DESCRIPTION.

FLOATING MANNA GRASS. An erect grass, 3 to 5 feet (6-10 dm.) high, with somewhat flattened culms, long leaves, and a narrow panicle, 1 foot ($2\frac{1}{2}$ dm.) long. Lower panicle-branches finally spreading. Spikelets linear, cylindrical, $\frac{1}{2}$ to 1 inch (1-2 cm.) long, seven to thirteen-



FIG. 189. *Glyceria Americana* a, —spikelet; b, empty and flowering glumes. (Div. Agros. U. S. Dept. Agri.)



FIG. 190. *Glyceria fluitans*—a, inflorescence; b, flowering glumes; c, spikelets. Div. Agros. U. S. Dept. Agri.)

flowered; empty glumes broad, hyaline, faintly nerved near the base, the first about $1\frac{1}{2}$ lines (3 mm.) long, the second a little longer; flowering glumes about 3 lines (6 mm.) long, seven-nerved, scabrous, obtuse, entire at the apex or obscurely toothed. Wet places, often in running water. June to September.

Common in eastern Iowa, especially along the Mississippi river. It forms floating islands in slow-moving and sluggish lakes and ponds.

DISTRIBUTION.

Iowa. 761 Armstrong (Pammel and Cratty); 669 Gilbert (Combs and Ball); Ames (Crozier); Wilton (Hitchcock); Ames (Hitchcock); Mt. Pleasant (Mills); 1048 Armstrong (Cratty); Muscatine 1301 (Reppert); 968 Story City (Pammel and Stewart); Ames 669 (Ball and Combs); Hamilton County (P. H. Rolfs); Johnson County, Armstrong (Cratty).

North America. Wet places, often in running water, Newfoundland to Alaska, south to New York (Parry), District of Columbia (Washington, Vasey), Ohio (Worthington, Horr), North Carolina, Tennessee, Texas and California (Yosemite, Bolander), Montana (J. Craig), Illinois (Lake View, Pammel).

General. Europe, Great Britain, Germany, etc., to Siberia to the Himalayas to northern Africa and Australia. Cosmopolitan.

4. GLYCERIA BOREALIS.

Glyceria borealis Pammel *Nov. Comb.*

Glyceria fluitans var. *angustata* Vasey. *Proc. Port. Soc. Nat. Hist.* 2: 91. 1895.

Panicularia borealis Nash. *Bull. Torr. Bot. Club.* 24: 348. 1897. Britton and Brown. *Ill. Fl.* 3: 505. *f.* 491a. 1898.

DESCRIPTION.

SLENDER MANNA GRASS. Culms erect from a creeping base, $1\frac{1}{2}$ to 5 feet (4.5-15 dm.) tall; sheaths generally longer than the internodes, almost closed, the uppermost one enclosing the base of the panicle; leaves linear, acuminate, 2 to 4 inches (6-12.5 cm.) long, 2 to $2\frac{1}{2}$ lines (4-5 mm.) wide; panicle slender, the exerted portion 1 to $1\frac{1}{2}$ feet (3-4 dm.) long, its branches appressed or nearly so; spikelets compressed-cylindric, 1 to $1\frac{1}{2}$ inches (2-2.8 cm.) long, seven to twelve-flowered; empty scales one-nerved, flowering scales scabrous all over, seven-nerved, about $2\frac{1}{2}$ lines (5 mm.) long, the obtuse apex obscurely and irregularly few-toothed; palea about 6 mm. long, acuminate, a little exceeding the scale. July to September. See figure 191, on page 276.



DISTRIBUTION.

Iowa. Ames (Carver); 761 Armstrong (Pammel and Cratty); Jewell Junction (Carver).

North America. From Maine to New York, Ohio (Painsville, Beardslee); California, Colorado (Grand County, Shear and Bessey), Washington and northward.

16. FESTUCA.

Festuca L. Sp. Pl. 73. 1753. Endlicher Gen. Pl. 101. Bentham and Hooker. Gen. Pl. 3: 1198. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 74. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 155. *f.* 124.

Schedonorus Beauv. Agrost. 99. 1812.

Vulpia Gmel. Fl. Bad. 1: 8. 1805.

Mygalurus Link. Hort. Berol. 1: 92. 1827.

Loretia Dur. Jour. Rev. Sci. Nat. 2: 238. 1874.

Spikelets three to many-flowered, panicle or racemose; the flowers not webby at base. Lower glumes unequal, mostly keeled. Flowering glumes chartaceous or almost coriaceous, roundish (not keeled) on the back, more or less three to five-nerved, acute, pointed, or often bristle-awned from the tip, rarely blunt; the palea mostly adhering at maturity to the enclosed grain. Stamens 1 to 3. Flowers, and often the leaves, rather dry and harsh. (An ancient Latin name of some kind of grass; of uncertain meaning.)

Bentham & Hooker give the number of species at 80, found chiefly in north temperate regions, although some authors extend the number to 230. Heller gives 36 for North America.

KEY TO THE SPECIES OF FESTUCA.

- Low plants, leaves short, very narrow, 2mm. wide or less, mostly involute; flowering glumes awl-shaped, mostly awned.
 - Low annual or biennial; panicle spike-like, one-sided; flowering glumes long awned..... *F. octoflora*.¹.
 - Perennial from root-stocks; panicle often red, open in flowering, contracted in fruit, awn short or wanting... *F. rubra*.².
- Taller plants, leaves long, usually 4mm. wide or over, flat; flowering glumes oblong or lanceolate, usually awnless.
 - Panicle contracted, spikelets 5-10-flowered; flowering glumes 5-7 mm. long..... *F. pratensis*.³.
 - Panicle open; spikelets 3-6-flowered; flowering glumes about 4 mm. long.
 - Spikelets very broad; panicle branches spikelet-bearing from the middle or below..... *F. Shortii*.⁴.
 - Spikelets lanceolate, panicle branches long, finally nodding, spikelet-bearing at the ends... *F. nutans*.⁵.

1. *FESTUCA OCTOFLORA*.

Festuca octoflora Walt. Fl. Car. 81. 1788. Beal. Grasses of N. A. 2: 586. 1896. Nash in Britton and Brown. Ill. Fl. 1: 216. f. 497. 1896. Bull. U. S. Dept. Agrl. Div. Agros. 17: 284. f. 580. 1899.

Festuca tenella Willd. Watson and Coulter. Gray. Man. Bot. 669. 1890. (6 ed.)

DESCRIPTION.

SLENDER FESCUE GRASS. A slender, erect, more or less caespitose annual, $\frac{1}{2}$ to $2\frac{1}{2}$ feet (1-5 dm.) high, with narrow, simple panicles, 1 to $7\frac{1}{2}$ inches (2-15 cm.) long. Spikelets five to thirteen-flowered, 3 to 5 lines (6-10 mm.) long, with slightly unequal, acute, empty glumes and



FIG. 191. *Glycyeria borealis*—a, spikelets; b, empty glumes; c, flowering glumes; d, palea. (Charlotte M. King.)



FIG. 192. *Festuca octoflora*—a, lower or outer glumes; b, spikelet. (Div. Agros. U. S. Dept. Agrl.)

narrow, usually scabrous, short-awned or nearly awnless flowering glumes $1\frac{1}{2}$ to $2\frac{1}{2}$ lines (3-5 mm.) long. May to August.

Festuca octoflora is common in sandy soil and on gravelly knolls in all parts of the state. Very variable as to size.

DISTRIBUTION.

Iowa. Greenfield (Stewart); 131 Ames, 1363 Cordova, Jefferson (Carver); 1366 Cordova (Pammel); Lyon County, Johnson County, 1 Cedar Rapids (Shimek); Des Moines (Carver); 1031 Harcourt (Danielson); Iowa City (Hitchcock); Sioux City (Miss Wakefield); Winterset (Carver); Ames (Crozier, Hitchcock, Bessey); Hamilton County to Hancock County (Preston); Johnson County (Shimek, Macbride, Hitchcock); Cedar Rapids, Lyon County northwest corner of state (Shimek); Johnson County (Miss Linder).

North America. From Ohio (Baltimore Horr; Lancaster Sullivan), South Carolina (Pickens County, Anderson), to Florida, Illinois (Mead; Red Bud and Lake View, Pammel), Wisconsin (La Crosse, Pammel), Minnesota (Carmen County, Sandberg), Nebraska (70 Alma, 394 and 406 McCook, 369 Grand Island, Crete, Pammel), Missouri (Crystal City, Pammel), Texas (Coleman), Arkansas (Harvey), Colorado (Ft. Collins, Denver and Golden, Pammel), Wyoming (New Castle, Pammel), Utah (1606, 886 and 885 Black's Fork and La Motte Peak), Utah and Arizona (Palmer), Idaho (Lewiston, Sandberg, Heller and McDougal), California (Parry).

2. FESTUCA RUBRA.

Festuca rubra L. Sp. Pl. 74. 1753. Nash in Britton and Brown. Ill. Fl. 1: 216. f. 499.

DESCRIPTION.

RED FESCUE GRASS. Erect, smooth and glabrous, from underground root-stocks. Culms simple, $1\frac{1}{2}$ to $2\frac{1}{2}$ feet (4.5-7.5 dm.) tall. Sheaths shorter than the internodes; ligule very short, truncate; culm leaves finely pubescent above, short, erect; basal leaves involute, 3 to 6 inches (7-14 cm.) long. Panicle often reddish, expanded when in flower, contracted in fruit, 2 to 5 inches (5-12 cm.) in length. Spikelets 4 to 6 lines (2-3 mm.) long, three to ten-flowered. The lower

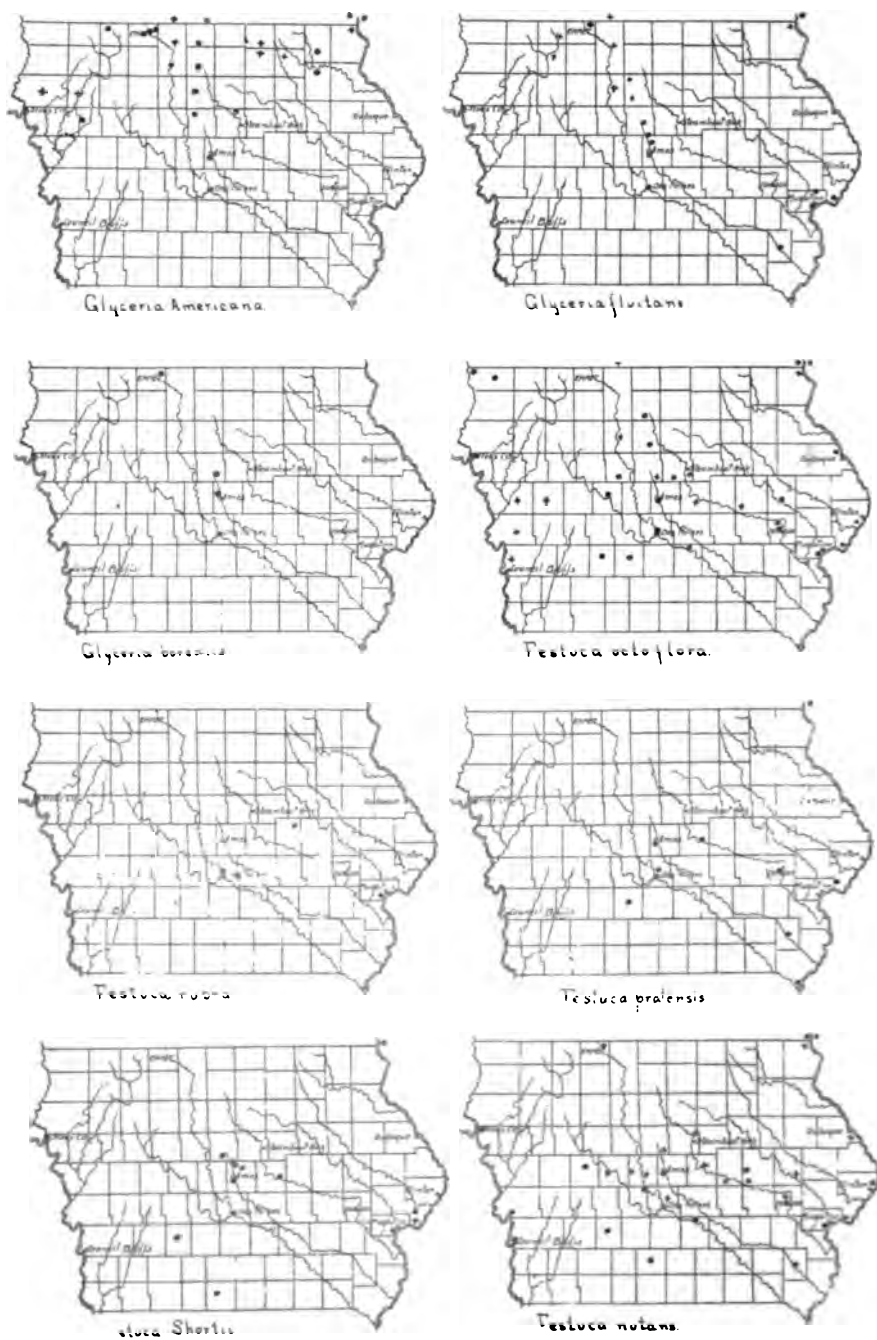


FIG. 193. Distribution of *Glyceria* and *Festuca*. ● Specimens in herbarium. † Localities observed.

glumes are acute, unequal, the first one-nerved, shorter than the three-nerved second; flowering glumes 3 lines long. Awns of less length than the flowering glume. July to August.



FIG. 194. *Festuca rubra*—a, spikelet; b, flowering glume and palea.
(Charlotte M. King.)

DISTRIBUTION.

Iowa. Dysart (Sirriner); 670 Dysart (Miss Sirriner); Ames (Sirriner). See page 281, foot note, for *Festuca ovina*.

North America. Colorado (Larimer County, 70 Pammel), Utah (West Bear River, 76 and 84, Pammel and Stanton), Wyoming (Griffith and Williams; Sheridan, Pammel), California (Anderson).

General. Found in Europe from the British Islands, east through Europe and Asia.

3. FESTUCA PRATENSIS.

Festuca pratensis Huds. Fl. Anl. 37. 1762. (ed. 1).

Festuca elatior L. var. *pratensis* Gray. Watson and Coulter, Gray. Man. Bot. 659. pl. 10. 1890. (6 ed.)

Festuca elatior L. var. *pratensis* Hackel. Scribner, Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 116. f. 163. 1894.

Festuca elatior L. var. *pratensis* (Huds.) Hack. Beal. Grasses of N. A. 2: 592. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 294. f. 288. 1900 (3 ed.)

Festuca elatior. Nash. in Britton and Brown. Ill. Fl. 1: 217. f. 502. 1896.



FIG. 195. *Festuca pratensis*—a, spikelet. (Div. Agros. U. S. Dept. Agr.)

DESCRIPTION.

TALL OR MEADOW FESCUE GRASS. Perennial, culms 1 to 3 feet (2-6 dm.) high, erect; sheath striate, smooth; ligule short; leaves long,

linear lanceolate. Panicle 5 to 8 inches (10-16 cm.) long, oblong or linear, somewhat one-sided, usually erect, nearly simple, the branches solitary or the lower in pairs, with few (1 to 4) spikelets. Spikelets lanceolate, 6 lines (12 mm.) long, five to ten-flowered, empty glumes unequal, flowering glumes lanceolate, acute. June to August.

Occasionally cultivated. An excellent forage plant, but not adapted to Iowa.

DISTRIBUTION.

Iowa. Ames (Sirriner); 3219 Clinton (Pammel); Bartlett (Chambers); Des Moines (Wallace); Lineville (Shimek); Ames (Sirriner, Bessey, 1173 Pammel, 284 Pammel, 142 Ball, Weaver); Iowa City (Macbride); Mt. Pleasant (861 Mills); Marshalltown (Eckles); Iowa City (Hitchcock); Sioux City (Miss Wakefield); Blue Grass (Barnes); Winterset (Carver); Keokuk (Hitchcock).

North America. Introduced into Nova Scotia, Massachusetts (Cambridge, Pammel), New York (Parry), to North Carolina, west to South Dakota (Belle Fourche, Griffith), Nebraska (Grand Island, Pammel), Washington, Oregon and Kansas.

General. Found throughout Europe well up into the Arctic regions, also eastward into Siberia.

4. FESTUCA SHORTII.

Festuca Shortii Kunth. Wood's Class-book of Botany. 794. 1861. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 116. f. 165. 1894. Nash in Britton and Brown. Ill. Fl. 1: 218. f. 503. 1896.

Festuca nutans var. *Shortii* (Kunth.) Beal. Grasses of N. A. 2: 589. 1896.

Festuca obtusa Spreng. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 278. f. 574. 1899.

DESCRIPTION.

SHORT'S FESCUE. Culms about 3 feet (6 dm.) high. Sheaths smooth; ligule very short, leaf-blade 4 to 7 inches (8-15 cm.) long, 2 to 3 lines (4-6 mm.) wide, acute, scabrous. Panicle 4 to 7 inches (8-15 cm.) long, nodding, the scabrous branches in pairs below, the lower

Festuca ovina. L. Sp. Pl. 73. 1753. Watson and Coulter Gray Man. Bot. 669. 1890. Beal. Grasses N. A. 2: 593. 1896. Scribner, Grasses Tenn. Bull. Univ. Tenn. 7: 115. pl. 40. Bull. U. S. Dept. Agrl. Div. Agros. 17: 281. f. 577.

DESCRIPTION.

SHEEP'S FESCUE. A slender, densely tufted, erect perennial. $\frac{3}{4}$ -2 feet (2-3 dm.) high, with narrow or filiform, involute leaves, and contracted (expanding while in bloom) panicles $1\frac{1}{2}$ -2 $\frac{1}{2}$ inches (3-6 cm.) long. Spikelets 3-5 flowered, with empty glumes, and unusually short awned, smooth flowering glumes $1\frac{1}{2}$ -2 lines (3-4 mm.) long.

DISTRIBUTION.

Occasionally cultivated in Iowa.

ones 2 to 4 inches (4-8 cm.) long. Spikelets obovate, 2 to 3 lines (4-6 mm.) long, three to four-flowered, usually much longer than the pedicels; empty glumes lanceolate, acute, slightly unequal, the first one-nerved, the second three-nerved, scabrous on the keels, usually about the length of the approximate floral glumes; flowering glumes 2 to 2½ lines (4-5 mm.) long, rigid, ovate-oblong, rounded on the back, obtuse, obscurely nerved. Palea broad, strongly two-keeled, about as long as the glumes. Grain obovate, pubescent at the apex. Open woods and thickets. July to August.

This species is most closely allied to *F. nutans*, the spikelets and flowers, however, are larger, and the plant occurs in low, marshy grounds. Common in central and eastern Iowa to the Missouri river.



FIG. 196. *Festuca Shortii-n.*, empty glumes; b, flowering glumes. (Div. Agros. U. S. Dept. Agr.)



FIG. 197. *Festuca nutans*—a, spikelet; b, flowering glume; c, palea. (Charlotte M. King.)

DISTRIBUTION.

Iowa. 36 Gilbert (Ball and Combs); Ames (Beardslee, Hitchcock, Fisher); "Watkin's Well," 666 Gilbert (Ball and Combs); 286 Marshalltown (Eckles); Greenfield (Stewart); 278 Wheatland (Ball); Hamilton County (P. H. Rolfs); Scott County, Decatur County (Fitzpatrick); 966 Story City (Pammel); Story City (Stewart); Scott County (Barnes and Miller).

North America. Pennsylvania to Illinois, Tennessee, Kansas, Missouri (St. Louis, Eggert); Mississippi, Texas and Montana (Craig).

5. FESTUCA NUTANS.

Festuca nutans Willd. Enum. 1: 116. 1809. Watson and Coulter. Gray. Man. Bot. 669. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull Univ. Tenn. Agrl. Exp. Sta. 7: 117. f. 166. 1894. Nash in Britton and Brown. Ill. Fl. 1: 218. f. 504. 1896.

Festuca nutans Spreng. Beal. Grasses of N. A. 2: 588. 1896.

DESCRIPTION.

NODDING FESCUE. An erect perennial, with simple, smooth stems, 2 to 3 feet (5-7 dm.) high. Sheaths smooth or sometimes pilose, striate; ligule short and irregularly dentate; leaf-blade linear-lanceolate, 6 to 12 inches (12-24 cm.) long, strongly nerved, somewhat scabrous, dark green. Panicle slender, diffuse, at length nodding, the long, scabrous branches usually in pairs, and naked below. Spikelets about 3 lines (6 mm.) long, ovate-lanceolate, two to five-flowered; empty glumes unequal, lanceolate, acuminate pointed, scabrous on the keel; flowering glumes rigid or somewhat coriaceous, rounded on the back, acute, smooth and apparently nerveless. Rocky woods. June to August. See figure 197, on page 282.

DISTRIBUTION.

Iowa. Ames (Carver, 7 Ball and Sample, 4 Beardslee, Bessey, 156 Ball, 1153 Louthan, Pammel, F. Rolfs, C. A. Wilson); 3200 Missouri Valley, 3243 Beaver, Sioux City, 782 Sioux City, 1362 Cordova, 1424 Carroll, 1275 Council Bluffs, 1162 Ames (Pammel); Johnson County (Shimek); Iowa City (Hitchcock); 854 Emmet County (Pammel and Cratty); Sioux City (Miss Wakefield); Mt. Pleasant (Mills); Greenfield (Stewart); Keystone (Koch); Osceola (Stewart); Mt. Pleasant, 2 (Mills); High Bridge (Shimek); Johnson County (Miss Linder, Preston).

North America. Nova Scotia to Ontario and Nebraska, Missouri (Crystal City and St. Louis, Pammel; Prairie Dupont, Eggert) south to Florida and Texas, 1618 (Reverchon); Ohio (Pickerington, Horr), Wisconsin (La Crosse, Pammel).

17. BROMUS.

Bromus L. Sp. Pl. 76. 1753. Endlicher Gen. Pl. 101. Bentham and Hooker Gen. Pl. 3: 1200. Hackel in Engler and Prantl Nat. Pflanz. Fam. II. 2: 75. f. 88. Scribner. Bull. U. S. Dept. Agr. 20: 156. f. 125.

Schedonorus Beauv. Agrost. 99. 1812.

Anisantha C. Koch. Linn. 21: 394. 1847.

Serrafalcus Parlat. Pl. Nov. 75. 1842.

Spikelets five to many-flowered, panicked. Glumes unequal, membranaceous; the lower 1 to 5 (the upper 3-9) nerved. Flowering glume either convex on the back or compressed-keeled, 5 to 9-nerved, awned or bristle-pointed from below to the groove of the oblong or linear grain. Stamens 3. Styles attached below at the apex of the ovary. Coarse grasses, with large spikelets, at length drooping, on pedicels thickened at the apex. (An ancient name for the oat, from a Greek word for food.)

Bentham & Hooker and Hackel give the number of species at 40; Bentham & Hooker divide the genus up into four sections. Beal lists 27 species native and introduced into North America. Monographers in recent years have greatly increased the number of species; Shear in his monograph recognizes 35 species, as occurring in North America. Britton in his manual describes 14 species.

KEY TO THE SPECIES OF BROMUS.

- A. Lower, empty glume one nerved, the upper three nerved.
 - 1. Perennial; panicle erect, contracted (except in flower); flowering glumes glabrous, awnless or merely awn-pointed *B. inermis*.¹.
 - 2. Perennial; panicle open, its branches widely spreading or drooping; flowering glume pubescent; awn shorter than the glume.
 - a. Empty glumes sparsely pubescent; flowering glumes sparsely over the back *B. purgans*.².
 - (1) Sheaths densely soft pilose-pubescent throughout.
 - *B. purgans* var. *incanus*.³.
 - (2) Sheaths with a conspicuous, pilose-pubescent ring at the summit *B. purgans* var. *latiglumis*.⁴.
 - b. Empty glumes smooth; flowering glume densely appressed, pubescent on the margins for about three-fourths of its length *B. ciliatus*.⁵.
 - Flowering glumes smooth, or only slightly pubescent.
 - *B. ciliatus* var. *laeviglumis*.⁶.
 - 3. Low annual; panicle weak, open, its branches drooping; awn 12-16mm. long, longer than the hairy, flowering glume.
 - *B. tectorum*.⁷.
- B. Lower empty glume 3-5 nerved, the upper 5-9 nerved.
 - 1. Flowering glume pubescent.
 - a. Panicle small open; flowering glume densely silky; awn 2-3mm. long *B. Kalmii*.⁸.

- b. Panicle small, contracted; spikelets small, 12-15mm. long, not compressed; awn 6-9mm. long. *B. hordeaceus*.⁹.
 - (a) Spikelets glabrous or scabrous throughout.
 - B. hordeaceus* var. *glabrescens*.¹⁰.
 - c. Panicle large, contracted in fruit, 1-2dm. long, spikelets large, 2-4 cm. long, strongly compressed laterally; awn 4-7mm. long. *B. marginatus*.¹¹.
 - (a) Panicle larger, 2-3dm. long, awn slightly longer.
 - B. marginatus* var. *latior*.¹².
 - d. Panicle large, 1.5-2.5 dm long, pyramidal; spikelets compressed, 2.5-3cm. long; awn 7-10 mm. long.
 - B. carinatus*.¹³.
2. Flowering glume glabrous or roughened.
- a. Awn straight or merely undulate.
 - (a) Sheaths glabrous, the lower sparsely pubescent; spikelets broadly lanceolate in fruit; flowering glumes turgid, the margin strongly involute in fruit; undulate awn usually 3-5mm. long; palea equalling or only slightly shorter than the glume. *B. secalinus*.¹⁴.
 - (b) Sheaths densely pilose-pubescent; panicle small, typically simple; spikelets always acute, awn straight, 5-8 mm. long; Palea shorter than the glume.
 - B. racemosus* var. *commutatus*.¹⁵.
 - (c) Sheaths as in last; panicle larger, broad, compound; spikelets lanceolate, 2 cm. or over long; awn straight, 7-10 mm. long; palea shorter than the glume.
 - B. arvensis*.¹⁶.
 - b. Awn twisted and strongly divaricate at maturity.
 - (a) Spikelets usually more than 5mm. broad in flower.
 - B. squarrosus*.¹⁷.
 - (b) Spikelets usually less than 5 mm. broad in flower.
 - B. patulus*.¹⁸.

1. BROMUS INERMIS.

Bromus inermis Leyss. Fl. Hal. 16. 1761. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 118 f. 160. 1894. Beal. Grasses of N. A. 2: 612. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 296. f. 290. 1900. (3 ed.)

Schedonorus inermis Beauv. Agrost. 99. 1812.

DESCRIPTION.

SMOOTH BROME OR HUNGARIAN BROME GRASS. An erect perennial, 2 to 5 feet (6-9 dm.) high, with creeping root-stocks, open panicles, 5 to 7 inches (12-18 cm.) long, and five to nine-flowered, awnless spikelets, 1 to 1½ inches (2-3 cm.) long. Sheaths striate, smooth, or the lower ones pilose; leaf-blades 4 to 8 inches (10-20 cm.) long, 3 to 4 lines (6-8 mm.) wide, somewhat scabrous, the lower often sparingly pilose.

Rachilla pubescent; empty glumes unequal, the flowering glumes awnless, or very short-awned, with a rather broad, scarious margin at the obtuse or emarginate apex. Introduced from Europe. Cultivated in United States for hay. June to July.

Hungarian brome grass is well established in different sections of the state, and has been widely scattered in recent years. A valuable grass for Iowa.



FIG. 198. *Bromus inermis*—a, spikelet; b, back of flowering glume; c, flowering glume and palea. (Div. Agros. U. S. Dept. Agr.)



FIG. 199. *Bromus purgans*—a, spikelet; b, awned flowering glume. (Div. Agros. U. S. Dept. Agr.)

DISTRIBUTION.

Iowa. Ames (151 Ball, 1166 Pammel, Stewart, Sirrine, Weaver); Keystone (Koch); Battle Creek 955 (Preston); Hull (Newell); Harcourt (Danielson).

North America. Introduced throughout the west, Wisconsin (La Crosse Pammel) Colorado (Ft. Collins, Crandall; Ft. Collins and Larimer County, Pammel).

General. In Europe, France, Holland, Germany, Switzerland, Austria, Russia to Asia, Caucasus and Siberia.

2. BROMUS PURGANS.

Bromus purgans L. Sp. Pl. 1: 76. 1753.

Bromus ciliatus var. *purgans* Gray. Man. Bot. 600. 1848. (1 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 118. f. 168. 1894. Watson and Coulter. Gray. Man. Bot. 670. 1890. (6 ed.) Beal. Grasses of N. A. 2: 619. 1896. Nash in Britton and Brown. Ill. Fl. 1: 219. f. 506. 1896.

Bromus purgans L. Shear. Bull. U. S. Dept. Agrl. Div. Agros 23. 39. f. 22. 1900.

DESCRIPTION.

BROME GRASS. A rather stout perennial, $3\frac{1}{2}$ to 7 feet (7-14 dm.) high. Culms erect, smooth or pubescent at the nodes. Sheaths usually coarsely retrorse-pilose; ligule $\frac{1}{2}$ to 1 line (1-2 mm.) long, rather firm, truncate; blades broadly linear-lanceolate, $7\frac{1}{2}$ to 15 inches (15-30 cm.) long, $2\frac{1}{2}$ to $7\frac{1}{2}$ lines (5-15 mm.) broad, somewhat auricled at the base, short-pilose on the nerves above or smooth, scabrous or smooth beneath. Panicle large, lax, nodding, mostly $7\frac{1}{2}$ to $12\frac{1}{2}$ inches (15-25 cm.) long; lower branches two to four, long, slender, flexuose. Spikelets mostly seven to eleven-flowered, 1 to $1\frac{1}{4}$ inches (2-2 $\frac{1}{2}$ cm.) long, terete-acuminate at first, becoming oblong-lanceolate in outline and somewhat flattened; empty glumes narrow, acuminate, sparsely covered with short pubescence; the lower one-nerved, $2\frac{1}{2}$ to $3\frac{1}{2}$ lines (5-7 mm.) long; the upper broader, three-nerved $3\frac{1}{2}$ to $4\frac{1}{2}$ lines (7-9 mm.) long; flowering glume lanceolate, acute, or sub-acute; five-nerved, or sometimes with two or more faint nerves when mature, 5 to 6 lines (10-12 mm.) long, with rather short, sparse pubescence over the back, emarginate or shortly bidentate at the apex; awn straight, slender, 2 to 3 lines (4-6 mm.) long; palea 1 to $1\frac{1}{2}$ lines (2-3 mm.) long, nearly equalling its glume, rachilla slender, pubescent. July to August. See figure 199, on page 287.

This is the most widely distributed brome grass in Iowa. The species occurs in woodlands where it was once common. Blue grass in many of our woodlands has taken the place of this and other native grasses.

DISTRIBUTION.

Iowa. Nodaway River (Stewart); Mason City 3132 (Miss King and Brown); Steamboat Rock 3026 (Miss King); Ames (Hitchcock, Thurber, Bessey, Crozier, Chas. Wilson, 121 and 123 Ball; see Shear, Bull. U. S. Dept. Agrl., Div. Agros. 23:40); Winterset, Boone (Carver); Marshalltown (Eckles); Colfax (Mead); Story City, Sioux City, 662 Grand Junction, Hawarden (Pammel); Mt. Pleasant 772 (Mills); Emmet County 1051, Armstrong (Cratty); Lebanon (Sample); Tama County (Sirrine); Appanoose County, Winneshiek County (Fitzpatrick); Iowa Lake 853 (Pammel and Cratty); Winneshiek County (Bartsch); Lebanon 26 (Ball and Sample; see Shear, Bull. U. S. Dept. Agrl., Div. Agros. 23:40); Fayette County (Fink; see Shear, Bull. U. S. Dept. Agrl. Div. Agros. 23:40); Decatur County (Fitzpatrick; see Shear, Bull. U. S. Dept. Agrl. Div. Agros. 23:40); Myron (Miss King); Hackberry Grove (Shimek); Quarry (Pammel); Morgan, Decatur County (Shimek); Skunk River (Glendale); Ft. Dodge (Oleson).

North America. New England to Florida; Ohio (Baltimore, Horr; Columbus, Sullivan), Kentucky (Harlan County, Kearney 276), west to Wyoming and Colorado (Golden, alt. 7500 ft., Pammel 261), south to Texas.

General. Kamtschatka.

3. BROMUS PURGANS VAR. INCANUS.

Bromus purgans var. *incanus* Shear. Bull. U. S. Dept. Agrl. Div. Agros. 23: 41. 1900.

DESCRIPTION.

WOOD CHLSS OR WOOD BROME GRASS. This is very near *B. purgans latiglumis*, differing from it in having the sheaths densely soft pilose-pubescent. It also passes into *B. Porteri* var. *lanatipes* in the southwest. It is generally separated from that by its broader leaves and narrower empty glumes, which are, like the flowering glumes, sparsely pubescent. July to August.



FIG. 200. *Bromus purgans* var. *incanum*—a, spikelet. (Charlotte M. King.)



FIG. 201. *Bromus purgans* var. *latiglumis*—a, spikelet; b, flowering glume; c, palea. (Charlotte M. King.)

DISTRIBUTION.

Iowa. Fayette 1084 (Fink; see Shear, Bull. U. S. Dept. Agr., Div. Agros. 23:41); Sioux City (Wakefield) Greenfield (Stewart); Mt. Pleasant (Mills); Ames (Rich and Gossard, Sirrine, Hitchcock).

North America. Pennsylvania, Ohio, Iowa, South Dakota and Texas.

4. *BROMUS PURGANS* VAR. *LATIGLUMIS*.

Bromus purgans var. *latiglumis* (Scribn.) Shear. Bull. U. S. Dept. Agr. Div. Agros. 23: 40. 1900.

Bromus altissimus Pursh. Fl. Am. Sept. 2: 728. 1814.

Bromus ciliatus porteri Rydb. Contr. U. S. Nat. Herb. 3: 193. 1895.

DESCRIPTION.

BROAD GLUMED BROME GRASS. Culms very leafy; sheaths usually much overlapping, and furnished with a rather conspicuous, pilose-pubescent ring at the summit. Spikelets and flowering glumes rather broader than in the species. The pubescence at the base of the flowering glume is slightly denser than elsewhere. In other respects like the species. July to August. See figure 201, on page 289.

DISTRIBUTION.

Iowa. Boone (Carver); Mt. Pleasant (Mills); Woodbine (Burgess); Ames, Iowa City (Hitchcock, P. H. Rolfs, F. Rolfs, Ball; see Shear, Bull. U. S. Dept. Agrl. Div. Agros. 23:41); Spirit Lake (Miss Wakefield); Decatur County (Fitzpatrick); Jackson County (see Shear, Bull. U. S. Dept. of Agrl. Div. Agros. 23:41); Rock Rapids 32 (Shimek); Dakota City (see Shear, Bull. U. S. Dept. Agrl. Div. Agros. 23:41), Muscatine, Sioux City 222 (Pammel); Ames (Beardslee); Forest City (see Shear, Bull. U. S. Dept. Agrl. Div. Agros. 23:41, Shimek); Iowa City (Miss Linder); Mason City (Pammel); Steamboat Rock (Miss King).

North America. Connecticut, New York, Pennsylvania, Wisconsin (La Crosse, Pammel), South Dakota, Nebraska, Iowa, Montana and Missouri.

5. *BROMUS CILIATUS.*

Bromus ciliatus L. Sp. Pl. 76. Watson and Coulter. Gray. Man. Bot. 670. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 118. *f.* 167. 1894. Beal. Grasses of N. A. 2: 618 1896. Nash in Britton and Brown. Ill. Fl. 1: 219. *f.* 506. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 287. *f.* 583. 1899 Shear. Studies in Am. Grasses. Bull. U. S. Dept. Agrl. Div. Agros. 23: 31. 1900.

DESCRIPTION.

FRINGED BROME GRASS. A tall, rather slender, leafy perennial; with a broad, lax, drooping panicle. Culm erect, smooth or slightly pubescent at the dark nodes, about 3 to 6 feet (7-12 dm.) high. Sheaths retrorsely short-pilose, or nearly smooth, coarsely striate; ligule *very short*, rarely extending $\frac{1}{2}$ line (1 mm.); blades rather broadly linear-lanceolate, weak, about 1 to $2\frac{1}{2}$ feet (2.5-3.5 dm.) long, and $\frac{1}{2}$ inch (1 cm.) broad, typically sparsely pilose on both sides, but sometimes almost

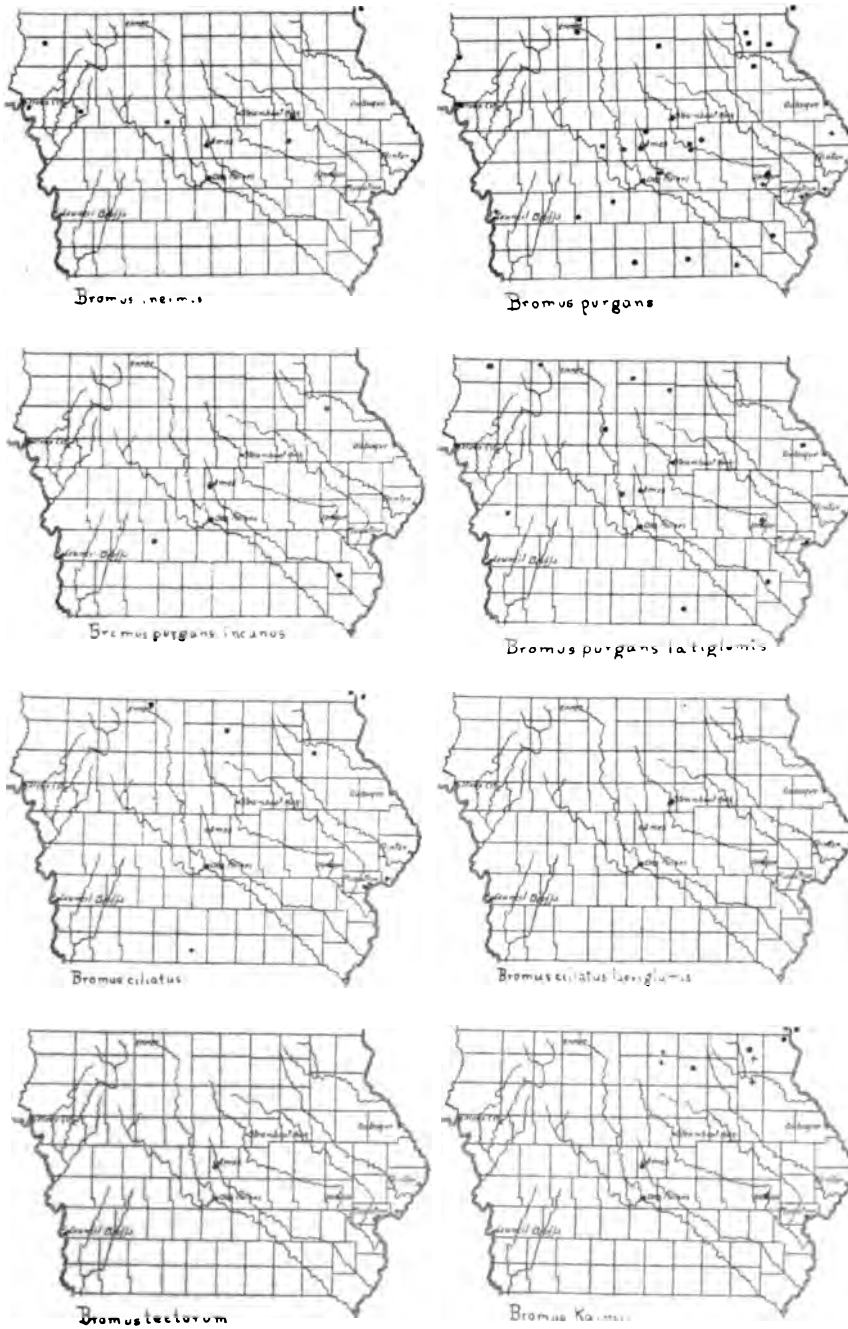


FIG. 202. Distribution of *Bromus*. ● specimens in herbarium † Localities observed.



FIG. 203. *Bromus ciliatus*—a, empty or outer glumes; b, flowering glume; c, palea (Div. of Agros. U. S. Dept. Agrl.)



FIG. 204. *Bromus ciliatus* var. *laeviglumis*—a, spikelet; b, flowering glume; c, palea. (Charlott M. King.)

smooth. Panicle very broadly pyramidal, about 1 to 2 feet ($1\frac{1}{2}$ - $2\frac{1}{2}$ dm.) long (lower branches 2 to 4 dm.), slender, flexuous, drooping. Spikelets narrow, five to nine-flowered, $7\frac{1}{2}$ to 11 lines (15-22 mm.) long, on slender, smooth pedicels; the lower one-nerved, acute, $2\frac{1}{2}$ to 4 lines (5-8 mm.) long, three-nerved; flowering glumes narrow, oblong-lanceolate, obtuse and slightly bifid at the apex, distinctly three, or faintly five to seven-nerved, ciliate-pubescent on each side from the outer nerve to the margin for about three-fourths the length, 5 to 6 lines (10-12 mm.) long; awn slender, straight, $1\frac{1}{2}$ lines ($2\frac{1}{2}$ mm.) long; palea narrow, nearly equalling the glume; rachilla slender, thinly pubescent. July to August.

The species occurs in woodlands, in central and eastern Iowa. A good forage grass.

DISTRIBUTION.

Iowa. Mason City 3137 (Miss King and Brown); West Union (Whitmore); Armstrong (Cratty); Traer (Provan); Ft. Dodge (Oleson).

North America. Newfoundland to New York (Parry), west to Manitoba, Wisconsin (La Crosse, Pammel; Lake Geneva, C. R. Ball; Lake Geneva, Ball and Taylor), Minnesota (Aitkin County 819, Silver Creek 905, Sandberg; St. Croix, Parry), Missouri (Eggert), Colorado (Ft. Collins, 6500 ft., Crandall; Grand County, Shear and Bessey 1541; La Poudre River 9200 ft., Pammel), New Mexico (Vasey 314), Idaho (Sandberg).

6. *BROMUS CILIATUS* VAR. *LAEVIGLUMIS*.

Bromus ciliatus laeviglumis Scrib. in herb. Shear. Bull. U. S. Dept. Agrl. Div. Agros. 23: 32.

DESCRIPTION.

SMOOTH GLUMED OR FRINGED BROME GRASS. Differs from the species in having the flowering glumes entirely smooth, or with a very slight amount of pubescence on the margin at the base. July to August. See figure 204, on page 292.

DISTRIBUTION.

Iowa. Steamboat Rock (Miss King).

North America. Maine and North Carolina.

7. *BROMUS TECTORUM*.

Bromus tectorum L. Sp. Pl. 77. 1753. Watson and Coulter. Gray. Man. Bot. 671. 1890. (6 ed.) Beal. Grasses of N. A. 2: 620. 1896. Nash in Britton and Brown. Ill. Fl 1: 220. f. 509. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 290. f. 586. 1899. (3 ed.) Shear. Bull. U. S. Dept. Agrl. Div. Agros. 23: 29. f. 13. 1900.

Schedonorus tectorum Fr. Summ. Veg. Scand. 1: 76. 1846-49.

DESCRIPTION.

DOWNY BROME GRASS. A slender, erect, leafy annual, 7 to 25 inches (1½-6 dm.) high, with narrow, softly pubescent leaves, and open, nodding panicles, 3 to 7½ inches (6-15 cm.) long. Spikelets five to



FIG. 205 *Bromus tectorum*—a, sterile or outer glumes; b, spikelet. (Div. Agros. U. S. Dept. Agr.)



FIG. 206. *Bromus Kalmiti*—spikelet, a, florescence, leaves and roots (Div. Agros. U. S. Dept. Agr.)

eight-flowered, with unequal, acuminate pointed, hirsute empty glumes, and rough or hirsute flowering glumes, 4 to 6 lines (8-12 mm.) long. Awns 6 to 8 lines (12-16 mm.) long. Waste places. July-August.

Introduced from Europe. A worthless, weedy grass. It has been found a few times near Ames.

DISTRIBUTION.

Iowa. Ames (Weaver).

North America. Waste places New England, New Jersey (Halsted 93), to Virginia and Ohio; Colorado (Ft. Collins, Crandall, Pam-

mell, E. D. Ball), Utah (Salt Lake City and Ogden, Pammel, 157 and 208), Wyoming (Yellowstone National Park, A. and E. Nelson, 6207); also California and Washington.

General. Europe.

8. BROMUS KALMII.

Bromus Kalmii Gray. Man. Bot. 600. 1848. (1 ed.) Watson and Coulter. Gray. Man. Bot. 670. 1890. (6 ed.) Beal. Grasses of N. A. 2: 624. 1896. Nash in Britton and Brown. Ill. Fl. 1: 221. *f.* 512. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 7: 288. *f.* 584. 1899.

DESCRIPTION.

KALM'S BROME GRASS. A rather slender, erect perennial, $1\frac{1}{2}$ to 4 feet ($4\frac{1}{2}$ -9 dm.) high, with usually pubescent sheaths and leaves, and nodding, few-flowered panicles, $2\frac{1}{2}$ -7 $\frac{1}{2}$ inches (5-15 cm.) long. Spikelets six to ten-flowered, 6 to 12 lines (12-24 mm.) long, on slender, flexuous pedicels; the first glume three-nerved, the second five to seven-nerved; the flowering glume about 4 lines (8 mm.) long, densely silky-pubescent, and short awned. Dry soils. June to August.

Kalm's Brome Grass is not widely distributed in Iowa. It occurs from Wisconsin through the northern counties in marshy ground. A valuable, perennial grass. See figure 206, on page 294.

DISTRIBUTION.

Iowa. Decorah (Holway); Charles City (Arthur); New Albin (Pammel); Iowa City, Ames (Hitchcock); Steamboat Rock (C. M. King).

North America. Usually marshy soil, Canada to Pennsylvania, New York (Parry), Wisconsin (La Crosse, Pammel), Minnesota (Aitkin, Sandberg 812), Colorado (Leadville, Trelease; Marshall Pass, Tracy; Larimer County, La Poudre River, Pammel 20), New Mexico (Vasey), Oregon (Cusick), Idaho and Utah.

9. BROMUS HORDEACEUS.

Bromus hordeaceus L. Sp. Pl. 77. 1753. Beal. Grasses of N. A. 1: 618. 1896. Nash in Britton and Brown. Ill. Fl. 1: 222. *f.* 513. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 289. *f.* 585. 1899. Shear. Bull. U. S. Dept. Agr. Div. Agros. 23: 18. *f.* 3. 1900.

DESCRIPTION.

SOFT CHESS. An erect, usually slender, pubescent annual, 1 to 3 feet (2-6 dm.) high, with flat leaves, and contracted panicles, 1 to 3 inches (2-6 cm.) long. Spikelets three to eight-flowered, $\frac{1}{2}$ to 1 inch (1.5-2 cm.) long, with pubescent glumes, the flowering ones $3\frac{1}{2}$ to $4\frac{1}{2}$



FIG. 207. *Bromus hordeaceus*—
a, empty or outer glumes; b, flower-
ing glumes; c, palea. (Div. Agroa.
U. S. Dept. Agri.)



FIG. 208. *Bromus hordeaceus* var. *glabrescens*—a
spikelet; b, floret; c, flowering glume; d, palea; e, fruit.
(Charlotte M. King.)

lines (7-9 mm.) long, obtuse and awned. Awns 3 to 4 lines (6-8 mm.) long. In fields and waste places throughout the state. May to August.

An introduced grass along railroads and in streets of cities. Nearly worthless as a forage plant.

DISTRIBUTION.

Iowa. Ames (Hodson, Serrine).

North America. In fields and waste places throughout the country, Michigan (Orion 1372, O. A. Farwell).

General. Europe.

10. *BROMUS HORDEACEUS* VAR. *GLABRESCENS*.

Bromus hordeaceus glabrescens (Coss.) Shear. Studies on Am. Grasses. Bull. U. S. Dept. Agr. Div. Agros. 23: 20. 1900.

Bromus mollis glabrescens Coss. Fl. Descr. Par. 654. 1845.

DESCRIPTION.

SMOOTH SPIKED SOFT CHESS. An erect, pubescent annual, 1 to 3 feet (2-6 dm.) high, leaves flat, panicles contracted, spikelets three to eight-flowered, spikelets glabrous or only scabrous. The flowering glumes obtuse, awns 3 to 4 lines (6-8 mm.) long. May to August.

In fields and waste places, a troublesome weed. See figure 208, on page 296.

DISTRIBUTION.

Iowa. Ames (Pammel, Hodson, Craig); Council Bluffs (Pammel).

North America. Introduced on the Atlantic, and common on the Pacific Coast.

General. Europe, Germany, France.

11. *BROMUS MARGINATUS*.

Bromus marginatus Nees. Steud. Syn. Pl. Gram. 322. 1854. Shear. Bull. U. S. Dept. Agr. Div. Agros. 23: 53. f. 33. 1900.

Bromus breviaristatus (Hook.) Buckl. Beal. Grasses of N. A. 2: 623. 1896. Nash in Britton and Brown. Ill. Fl. 1: 223. f. 518. 1896.

Bromus pauciflorus Nutt. in Herb. Acad. Nat. Sci. Phil. f. 33.

DESCRIPTION.

SHORT-AWNED CHESS. An erect, tufted, rather stout, short-lived perennial. Culm 3 to 6 feet (6-12 dm.) high, mostly puberulent or pubescent. Sheaths pilose-pubescent; ligule $1\frac{1}{2}$ to $1\frac{3}{4}$ lines (3-3.5 mm.) long, subrotund, laciniate; blades broad, linear-lanceolate, somewhat sparsely pilose-pubescent throughout, rather rough and coarse, 1 to 2 feet (1.5-2.5

dm.) long, 3 to 6 lines (6-12 mm.) wide. Panicle erect, rather narrow, mostly $\frac{1}{2}$ to 1 foot (1-2 dm.) long; lower branches 2 to 4 inches (5-10 cm.), lowest rarely more than $3\frac{1}{2}$ inches (7 cm.) long, and bearing two spikelets. Spikelets 1 to 2 inches (2.5-4 cm.) long, $2\frac{1}{2}$ to $3\frac{1}{2}$ lines (5-7 mm.) wide, oblong-ovoid to oblong-lanceolate, laterally compressed, somewhat turgid at maturity, mostly seven to nine-flowered, erect or



FIG. 200. *Bromus marginatus*—a, spikelet and empty glumes; b, dorsal view of flowering glumes. (Div. Agros. U. S. Dept. Agri.)

ascending, the uppermost subsessile; empty glumes, rather broad, scabrous to scabrous-pubescent, the lower subacute, three to five nerved, mostly $3\frac{1}{2}$ to $4\frac{1}{2}$ lines (7-9 mm.) long; the upper broader, obtuse, $4\frac{1}{2}$ to $5\frac{1}{2}$ lines (9-11 mm.) long, five to seven-nerved, the lateral nerves broad; flowering glume subcoriaceous, coarsely pubescent, ovate-lanceolate,

acute, $5\frac{1}{2}$ to 7 lines (11-14 mm.) long, mostly seven-nerved, with two very short, hyaline, subacute teeth at the apex, and a rather stout, straight awn, 2 to $3\frac{1}{2}$ lines (4-7 mm.) long; palea ciliate-pectinate on the keels, almost or quite equalling its glume. July to August.

Short awned chess is a valuable forage grass. It has been introduced locally in a few places. The species merits a wider distribution for cultivation.



FIG. 210. *Bromus marginatus latior*—a, spikelet; b, flowering glume; c, palea. (Charlotte M. King.)

DISTRIBUTION.

Iowa. Ames (2 and 148 Ball, Craig, Carver, Stewart, Pammel); Dysart (Miss Sirrine).

North America. Colorado (Larimer County, Pammel), Wyoming (Sheridan County, Pammel 96, 51, 148), Arizona, California (Donner Lake, Pammel), Washington (Sandberg and Leiberg 450), to Alberta.

12. BROMUS MARGINATUS VAR. LATIOR.

Bromus marginatus latior Shear. Bull. U. S. Dept. Agrl. Div. Agros. 23: 55. 1900.

DESCRIPTION.

LARGER SHORT AWNED CHES. A larger and stouter plant than the species, sometimes reaching 8 or 9 feet (17 or 18 dm.) high. Panicle larger, 1 to $1\frac{1}{2}$ feet (2-3 dm.) long, with longest, lower branches 5 to 10 inches (10-20 cm.) long, awn usually slightly longer, sometimes reaching 3 or $3\frac{1}{2}$ lines (6 or 7 mm.). Otherwise like the species. See Fig. 210 on page 299.

DISTRIBUTION.

Iowa. Ames 33 and 148 (Ball; see Shear, Bull. U. S. Dept. Agrl., Div. Agros. 23:55).

North America. New Mexico, Colorado, Utah, Arizona, Wyoming, Idaho, Washington, Oregon and California; also in northern United States.

13. BROMUS CARINATUS.

Bromus carinatus Hook. and Arn. Bot. Beech. Voy. Suppl. 403. 1841. Shear. Bull. U. S. Dept. Agrl. Div. Agros. 23: 59. f. 37. 1900.

Bromus Hookerianus minor Scrib. Beal. Grasses of N. A. 2: 614. 1896.

DESCRIPTION.

KEELED BROME. An annual or biennial, with erect culm, linear leaves, and erect or suberect panicle. Culm about 2 to 3 feet (5-8 dm.) high, slightly pubescent at the nodes, retrorsely soft pilose; ligule $1\frac{1}{2}$ to 2 lines (3-4 mm.) long, sublaciniate; blades flat, mostly narrow, about $\frac{1}{4}$ to 1 foot (1-2.5 dm.) long, $1\frac{1}{2}$ to 3 lines (3-6 mm.) broad, thinly pilose on both sides. Panicle pyramidal, somewhat lax, about $\frac{2}{3}$ to $1\frac{1}{3}$ feet (1.5-2.5 dm.) long; lower branches about 3, spreading or somewhat drooping. Spikelets lanceolate to suboblong-lanceolate, compressed, about 1 to $1\frac{1}{2}$ lines (2.5-3 cm.) long, and $2\frac{1}{2}$ lines (5 mm.) broad, five to nine-flowered; empty glumes lanceolate, acute, glabrous to slightly scabrous pubes-

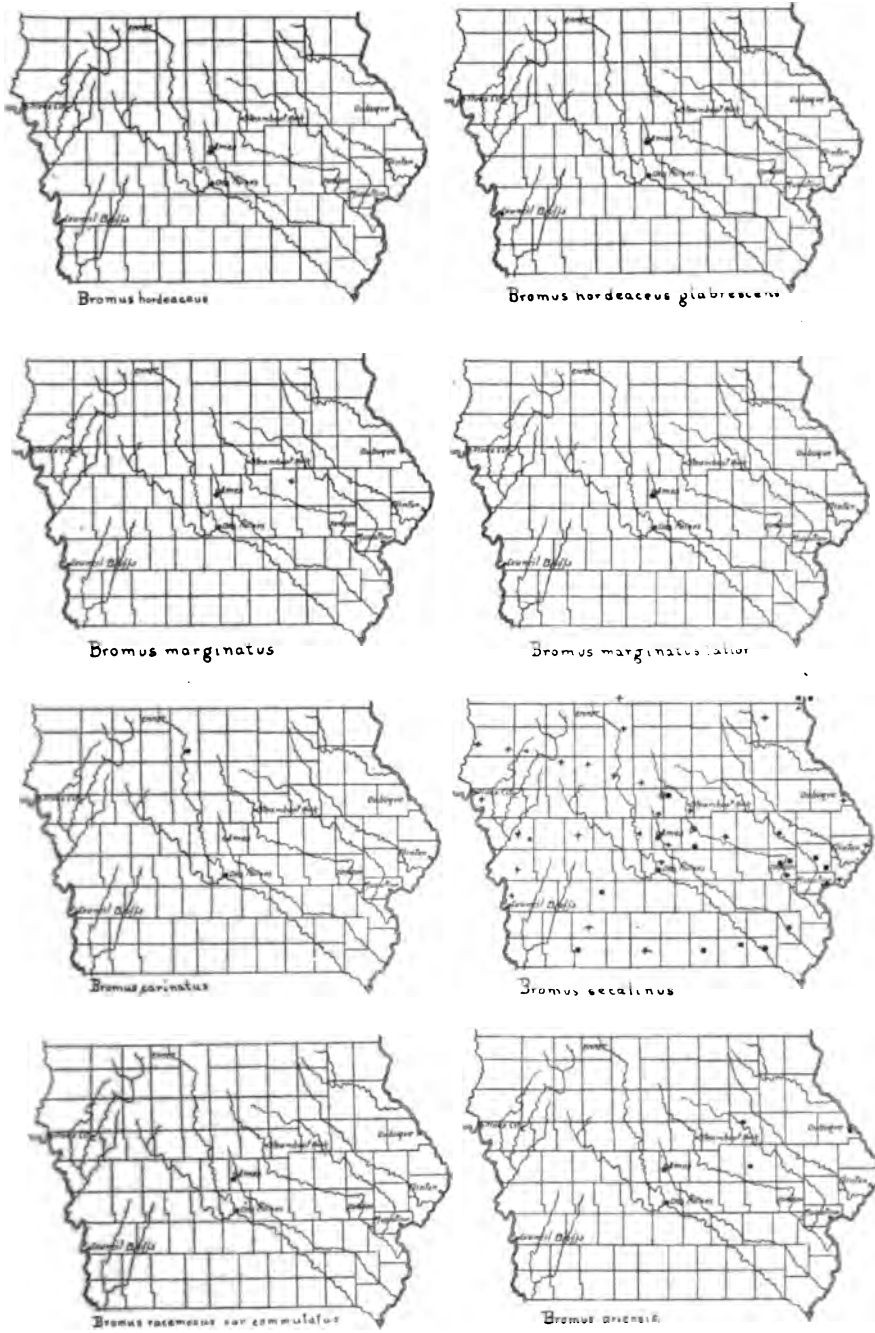


FIG. 211. Distribution of *Bromus*. ● Specimens in herbarium. + Localities observed.

cent; the lower distinctly three or obscurely five-nerved, $3\frac{1}{2}$ to $4\frac{1}{2}$ lines (7-9 mm.) long; the upper five or sometimes obscurely seven-nerved, $4\frac{1}{2}$ to $5\frac{1}{2}$ lines (9-11 mm.) long; flowering glume lanceolate, obscurely seven-nerved, puberulent or short pubescent, about $6\frac{1}{2}$ to 8 lines (13-16 mm.) long, bifid at the apex, and tapering into an awn $3\frac{1}{2}$ to 5 lines (7-10 mm.) long; palea nearly equalling its glume, ciliate-pectinate on the keels; rachilla slender, somewhat pubescent, about $1\frac{1}{2}$ lines (3 m.m) long.

DISTRIBUTION.

Iowa. Algona (Watson). This plant appears as a native, though it may have been introduced. If so, it places it far out of its ordinary range.

North America. Nevada to California, Oregon and Washington.



FIG. 212. *Bromus carinatus*—a, spikelet with empty glumes and 3 flowers; b, flowering glume. (Div. Agros. U. S. Dept. Agrl.)



FIG. 213 *Bromus secalinus*—a, spikelet. (U. S. Dept. Agr.)

14. BROMUS SECALINUS.

Bromus secalinus L. Sp. Pl. 76. 1753. Watson and Coulter. Gray. Man. Bot. 670. *pl.* 10. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 119. *f.* 170. 1894. Beal. Grasses of N. A. 2: 625. 1896. Nash in Britton and Brown. Ill. Fl. 1: 222. *f.* 514. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 297. *f.* 297. 1900. (3 ed.)
Serrafalcus secalinus Bab. Man. Brit. Bot. 374. 1843.

DESCRIPTION.

CHESS, CHEAT. An erect annual, 2 to 3 feet (5-8 dm.) high. Culms smooth or pubescent at the nodes. Sheaths striate, smooth, scabrous or sometimes pilose; ligule short, blunt; leaf-blade 6 to 12 inches (12-24 cm.) long, rather broadly linear, smooth beneath, more or less rough and pilose on the upper surface. Panicle 4 to 8 inches (8-16 cm.) long, erect, the more or less compound branches, spreading, even in fruit. Spikelets 6 to 10 lines (12-29 mm.) long, oblong-ovate, turgid, six to twelve-flowered, pendulous in fruit; empty glume, oblong-lanceolate, acute, the first three to five, the second seven-nerved; flowering glumes ovate-oblong, obscurely seven-nerved, smooth or minutely downy along the margins and toward the apex, becoming nearly cylindrical in fruit. Palea obtuse, strongly nerved; nerves toothed or fringed with distant bristles. Naturalized in cultivated and waste grounds. July-August.

A well known weed of grain fields, occurs in all sections of Iowa, but especially in the winter wheat sections. See figure 213, on page 302.

DISTRIBUTION.

Iowa. Ames (Pammel, Carver, Chas. Wilson, Preston, Stewart, Weaver, Beardslee, Hitchcock, Sirrine, 150 Ball; see Shear, Bull. U. S. Dept. Agrl. Div. Agros. 23:17); Muscatine (Reppert); Durant, 1144 (Weaver); Minerva 9 (Ball; see Shear, Bull. U. S. Dept. Agrl. Div. Agros. 23:17); Johnson County, New Market (see Shear, Bull. U. S. Dept. Agrl. Div. Agros. 23:17); Cedar Rapids (Shimek); Mt. Pleasant 858 (Mills); Greenfield (Stewart); Tipton (Hitchcock); Iowa City (Hitchcock); Sioux City (Miss Wakefield); Decatur County, Johnson County (Fitzpatrick); Van Cleve (Warden); Alden (Stevens); Pittsburg, Unionville (Pammel); Johnson County (Fitzpatrick).

North America. New York (Parry), Ohio (Horr), Missouri (St. Louis and Washington, Pammel; Kansas City, Forsee), Colorado (G. W. Letterman), Utah (Ogden 34, Pammel), Montana (Bozeman, Shear 453).

General. Great Britain, Germany, Scandinavia to northern Africa, western Siberia, naturalized generally in grain growing countries.

15. *BROMUS RACEMOSUS* ; VAR. *COMMUTATUS*

Bromus racemosus var. *commutatus* L. Sp. Pl. 114. 1762. (2 ed.) Watson and Coulter. Gray. Man. Bot. 670. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 120. f. 172. 1894. Beal. Grasses N. A. 2: 625. 1896. Nash in Britton and Brown. Ill. Fl. 1: 222. f. 515. 1896.

Bromus asper Murr. Prod. Stirp. Goett. 42. 1770.

DESCRIPTION.

UPRIGHT GRASS. An annual, 1 to 3 feet (2-7 dm.) high, with a nearly erect, sparingly branched panicle. Branches of the panicle slightly



FIG. 214. *Bromus racemosus* var. *commutatus*—a, spikelet (Charlotte M. King)



FIG. 215. *Bromus arvensis*—a, empty glume; b, part of spikelet, with lower florets open to show palea. (Div. Agros. U. S. Dept. Agrl.)

spreading, and somewhat nodding at the tips. Spikelets ovate-oblong, 6 to 9 lines (12-18 mm.) long, five to ten-flowered, flowering glumes round on the back, somewhat ventricose, shining, awned. Awns straight, about as long as the glumes. Common in cultivated fields and waste places. July and August.

This has become a weedy grass in central Iowa. At first introduced as a forage plant by Capt. R. P. Speer in 1889, at Ames, it has spread to railroads and streets.

DISTRIBUTION.

Iowa. Ames (1148 Louthan, 909 Pammel; see Shear, Bull. U. S. Dept. Agrl. Div. Agros. 23:18).

North America. Newfoundland, Manitoba, Maine to New York, District of Columbia (Washington, Conant), Michigan to Minnesota, Nebraska (Grand Island, Pammel 52, 97).

General. Western Europe, Great Britain, Germany to northern Africa.

16. BROMUS ARVENSIS.

Bromus arvensis L. Sp. Pl. 77. 1753. Beal. Grasses of N. A. 2: 626. 1896. Shear. Bull. U. S. Dept. Agrl. Div. Agros. 23: 20. f. 4. 1900.

DESCRIPTION.

FIELD BROME. A tufted annual or biennial, somewhat geniculate at the base. Culm nearly or quite glabrous, about $1\frac{1}{2}$ to 3 feet (3-6 dm.) high. Sheaths densely soft pubescent; ligule about 1 line (2 mm.) long, lacerate; blades linear, pubescent on both sides. Panicle effuse, broad, apex somewhat drooping; lower rays mostly 4 to 8. Spikelets terete acuminate at first, becoming slightly laterally compressed when old, about seven to eleven-flowered, $\frac{3}{4}$ to $1\frac{1}{4}$ inches ($1\frac{1}{2}$ to $2\frac{1}{2}$ cm.) long, $1\frac{1}{2}$ to 2 lines (3-4 mm.) broad, smooth or minutely scabrous throughout; empty glumes broad; the lower-subacute, three to five-nerved, 2 to $2\frac{1}{2}$ lines (4-5 mm.) long, the upper about seven-nerved, obtuse, $2\frac{1}{2}$ to 3 lines (5-6 mm.) long; flowering glume $3\frac{1}{2}$ to 4 lines (7-8 mm.) long, broad, obtuse, with the broad, hyaline margin projecting slightly into an obtuse angle just about the middle, apex hyaline, emarginate; awn inserted below the apex, $3\frac{1}{2}$ to 5 lines (7-10 mm.) long, straight or slightly twisted when old; palea shorter than its glume. July-August.

Introduced from Europe. This species is local in a few places, presumably introduced with European grass seed. See figure 215, on page 304.

DESCRIPTION.

Iowa. Ames (Carver, B. W. Wilson, C. A. Wilson, F. Rolfs, Hodson, 1151 Louthan); Cedar Falls (Carver); Keystone (Koch); Dubuque (Pammel).

North America. Introduced from Europe. Missouri (St. Louis, Pammel), Colorado (Ft. Collins, Crandall).

17. *BROMUS SQUARROSUS.*

Bromus squarrosus L. Sp. Pl. 76. 1753. Beal. Grasses of N. A. 2: 617. 1896. Nash in Britton and Brown. Ill. Fl. 1: 223. *f.* 516. 1896. Shear. Bull. U. S. Dept. Agr. Div. Agros. 23: 21. *f.* 6. 1900.

Serrafalcus squarrosus Bab. Man. Brit. Bot. 375. 1843.



FIG. 216. *Bromus squarrosus*—a, spikelet, with empty glumes and four flowers; b, awned flowering glume. (Div. Agros. U. S. Dept. Agr.)

DESCRIPTION.

CORN BROME. A more or less tufted annual, 1 to 2 feet (2-4 dm.) high, with a short, somewhat nodding panicle, and densely soft pilose sheaths. Culms erect or slightly geniculate at the base, smooth. Sheaths densely, retrorsely pilose-pubescent; ligule, about $\frac{1}{2}$ line (1 mm.) long; blades linear, about 4 to 7 inches (8-15 cm.) long, $1\frac{1}{2}$ to $2\frac{1}{2}$ lines (3-5 mm.) wide, softly pubescent on both sides. Panicle usually 3 to 6 inches (6-12 cm.) long, open, branches ascending or drooping, frequently flexuous. Spikelets oblong, ovoid, turgid, six to twelve-flowered, $7\frac{1}{2}$ to 10 lines (15-20 mm.) long; empty glumes broad, obtuse, glabrous, the lower three or indistinctly five-nerved, two-thirds to three-fourths the length of the upper, the upper seven to nine-nerved, 3 to 4 lines (6-8 mm.) long; flowering glume very broad, seven to nine-nerved, obtuse, with a broad, scarious margin, somewhat obtusely angled above the middle, glabrous or minutely scabrous, apex minutely notched; awn rather stout, attached below the apex, about the length of the glume, somewhat twisted and divergent, especially at maturity; palea a little shorter than its glume. In waste places. July-August.

Adventive from Europe.

DISTRIBUTION.

Iowa. Alden 1167 (Stevens).

North America. It has been found most frequently in waste places on the eastern coast.

General. Europe, Great Britain, Germany, France, etc.

18. BROMUS PATULUS.

Bromus patulus M. and K. Roehl. Deutsch. Fl. 1: 684. 1823. Shear. Bull. U. S. Dept. Agr. Div. Agros. 23: 21. f. 5. 1900.

Serrafalcus patulus Parl. Fl. Ital. 1: 394. f. 5. 1848.

DESCRIPTION.

SPREADING BROME GRASS. An annual or perennial, with culms smooth, erect, or somewhat geniculate at the base, about 2 to 3 feet (4-6 dm.) high. Sheaths softly pubescent; ligule 1 to $1\frac{1}{2}$ lines (2-3 mm.) long, subtruncate, lacinate throughout; blades linear-lanceolate, pubescent throughout. Panicle 6 to 10 inches (12-20 cm.) long, very broadly pyramidal, diffuse, somewhat drooping, lanceolate to ovoid-lanceolate.

terete at first, 1 to 1½ inches (2-2.5 cm.) long, 2½ to 3 lines (5-6 mm.) broad, becoming somewhat laterally compressed at maturity, smooth throughout; empty glumes rather broad, the lower narrower, acute, three-nerved, 2 to 3 lines (4-6 mm.) long; the upper obtuse, five-nerved, 6 to 8 mm. long; flowering glume nine-nerved, the marginal ones faint, 3½ to 4½ lines (7-9 mm.) long, broad, obtuse, with a hyaline margin,



FIG. 217. *Bromus patulus*—a, empty glumes; b, flowering glume. (Div. Agros. U. S. Dept. Agr.)

obtusely angled above the middle, and an emarginate apex; awn 4 to 5 lines (8-10 mm.) long, stout, somewhat twisted and strongly divaricate at maturity, inserted below the apex; palea conspicuously shorter than its glume. Introduced. July-August.

DISTRIBUTION.

Iowa. Ames (Miss Sirrine, Pammel, Shepherd, Stewart).

North America. Introduced into Massachusetts, South Dakota and Colorado (Ft. Collins, Pammel).

General. Europe.



FIG. 223. Flower of *Agropyron repens* (after Gray.)

TRIBE XII. HORDEAE.

Spikelets one to many-flowered, usually hermaphrodite, sessile along the common rachis, forming a simple or compound spike; glumes awned or awnless.

A small tribe of 20 genera and about 130 species. It is an important division, however, for it includes rye, barley and the many varieties of wheat. English and Italian rye grasses are the chief meadow grasses of the tribe.

KEY TO THE GENERA OF THE HORDEAE.

- A. Spikelets 1 at each joint of the rachis (sometimes more in *Agropyron*).
 - 1. Spikelets placed with one edge against the rachis; empty glume 1.
 - Lolium*.¹.
 - 2. Spikelets placed with the flat side against the rachis; empty glumes 2.
 - a. Flowering glumes with a distinct callus at the base, falling at maturity with the grain, which is adherent to the palea.
 - Agropyron*.².
 - b. Flowering glumes without a distinct callus, persistent grain free.
 - (1) Empty glumes subulate, 1-nerved.....*Secale*.³.
 - (2) Empty glumes lanceolate or ovate, 3-many-nerved.
 - Triticum*.⁴.
- B. Spikelets 2-3 or more at each joint of the rachis.
 - 1. Empty glumes nearly as large as the flowering glumes.
 - a. Spikelets 1-flowered, three at each joint; the lateral ones usually sterile.....*Hordeum*.⁵.
 - b. Spikelets 1-several-flowered, 2-3 or more at each joint, all with perfect flowers.....*Elymus*.⁶.
 - 2. Empty glumes minute or wanting*Asprella*.⁷.

1. LOLIUM.

Lolium L. Sp. Pl. 83 1753. Endlicher. Gen. Pl. 103. Bentham and Hooker. Gen. Pl. 3: 1202. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 77. Scribner. Bull. U. S. Dept. Agr. 20: 159. f. 127.

Spikelets many-flowered, solitary on each joint of the continuous rachis, placed edgewise; empty glumes, except in the terminal spikelet, only one (the upper) and external. Otherwise nearly as in *Agropyron*. (Ancient Latin name.)

Bentham & Hooker reduce the twenty described species, at the time of the publication of their work, to two or three; species indigenous to Europe, northern Africa, temperate Asia, and naturalized in many other temperate regions. Hackel lists six species; two species are more or less naturalized in the southern and eastern states, also upon the Pacific Coast. *The Lolium temulentum* accompanies grains wherever cultivated.

KEY TO THE SPECIES OF LOLIUM.

- A. Empty glumes shorter than the spikelet.
 - 1. Flowering glumes awnless.....*L. perenne*.¹.
 - 2. Flowering glumes awned.....*L. italicum*.².
- B. Empty glume equalling or exceeding the spikelet.....*L. temulentum*.³.

1. LOLIUM PERENNE.

Lolium perenne L. Sp. Pl. 83. 1753. Watson and Coulter. Gray. Man. Bot. 671. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 121. f. 175. 1894. Beal. Grasses of N. A. 2: 629. 1896. Nash in Britton and Brown. Ill. Fl. 1: 225. f. 521. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 301. f. 295. 1900. (3 ed.)

DESCRIPTION.

PERENNIAL RYE GRASS. A smooth, leafy perennial, 1 to 3 feet (2-6 dm.) high, with slender terminal spikes, 3 to 10 inches (6-20 cm.) long. Spikelets about 6 lines (12 mm.) long, five to twelve-flowered, rather distant, or crowded above; empty glume much shorter than the spikelet; flowering glumes obscurely nerved, obtuse, cuspidate, or very short awn-pointed. May to August.

Lawns, fields and waysides, naturalized, Canada to North Carolina, west to Ohio and Tennessee; California and Arizona. *Lolium perenne* has been introduced in different parts of the state. It, however, persists but a short time. An excellent forage plant. See figure 218, on page 311.

DISTRIBUTION.

Iowa. Ames (Sirriner, 224 Ball, Pammel, Hitchcock); Muscatine (Reppert); Dysart (Miss Sirrine); Shelby County (Fitzpatrick).

North America. Waste and cultivated grounds. Canada to North



FIG. 218. *Lolium perenne*—a, spikelet; b, flowering glume; c, palea (Div. Agros. U. S. Dept. Agrl.)

FIG. 219. *Lolium italicum*—a, spikelet; b, c, flowering glume; d, e, palea. (Div. Agros. U. S. Dept. Agrl.)

Carolina, west to Ohio, Tennessee, Missouri (Eggert), Texas (Nealley), California and Arizona.

General. Great Britain, Germany, Scandinavia, southern Lapland to northern Africa, western Asia, Falkland Islands.

2. *LOLIUM ITALICUM*.

Lolium italicum A. Br. Flora. 17: 259. 1834. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 122. f. 176. 1894. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 302. f. 296. 1900. (3 ed.)

Lolium multiflorum Lam. Beal. Grasses of N. A. 2: 629. 1896.

DESCRIPTION.

ITALIAN RYE GRASS. A biennial or perennial grass, 2 to 3 feet (6-9 dm.) high, with slender, usually somewhat nodding, terminal spikes, and short awned spikelets. Sheaths nearly smooth; ligule very short,

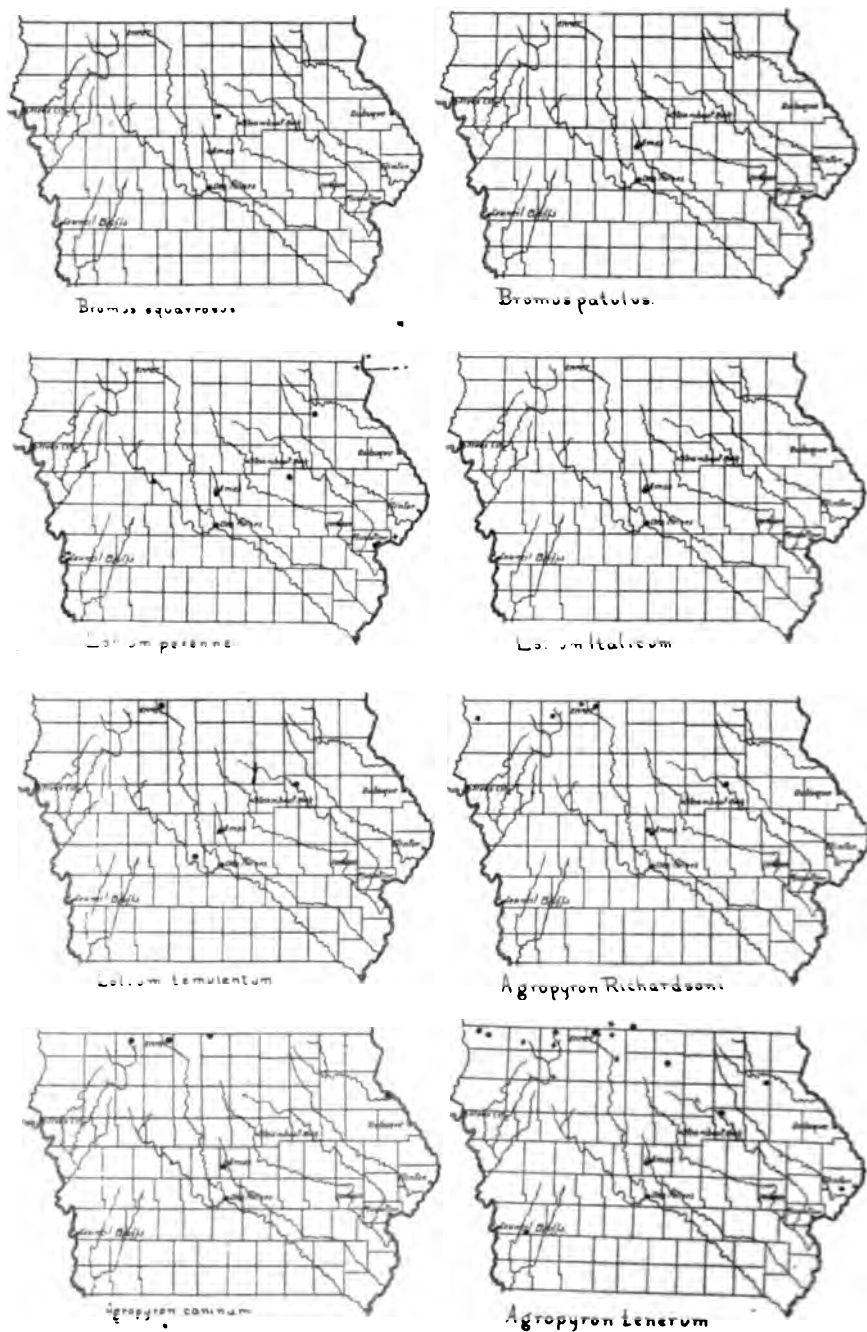


FIG. 220. Distribution of *Bromus*, *Lolium* and *Agropyron*.
 ● Specimens in herbarium. † Localities observed.

scarious; leaf-blades 4 to 8 inches (10-20 cm.) long, 2 to 3 lines (4-6 mm.) wide. Spikelets $5\frac{1}{2}$ to $7\frac{1}{2}$ lines (10-15 mm.) long, six to fifteen-flowered; flowering glumes scabrous near the summit, awned; awn slender, about the length of the glume. Introduced here and there through cultivation. May to July.

Lolium Italicum has been introduced as a cultivated plant in various sections of this state, but it seldom persists more than two years. An excellent forage plant, but not adapted to Iowa.



FIG. 221. *Lolium temulentum*—a, spikelet; b, empty glume. (Div. Agros. U. S. Dept. Agri.)

DISTRIBUTION.

Iowa. Ames (Crozier, Hitchcock, 160 Ball).

North America. Introduced here and there through cultivation, especially on the Pacific Coast. District of Columbia (Vasey).

General. Southern Europe, Spain, France, Germany, to Belgium, Switzerland, Italy, Dalmatia, Turkey and Greece. An escape from cultivation in Great Britain.

3. *LOLIUM TEMULENTUM.*

Lolium temulentum L. Sp. Pl. 83. 1753 Watson and Coulter. Gray. Man. Bot. 671. pl. 11. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 122 f. 177. 1894. Beal. Grasses of N. A. 2: 630. 1896. Nash in Britton and Brown. Ill. Fl. 1: 225. f. 522. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 291. f. 587. 1899.

DESCRIPTION.

POISON DARNEL. An annual, with smooth, stout, culm, 2 to 3 feet (4-6 dm.) high. Sheaths scabrous; ligule short. Spike 6 to 12 inches (12-24 cm.) long. Spikelets five to seven-flowered; empty glumes sharp-pointed, as long as the spikelet; flowering glumes turgid, awned or awnless, shorter and broader than in *L. perenne*. Wet places and cultivated grounds. June to August. See figure 221, on page 313.

Poison darnel is found in the wheat growing sections of the state.

DISTRIBUTION.

Iowa. Ames (Bessey, Hitchcock); Armstrong (Pammel); Charles City (Arthur); Cedar Falls (Carver); Dallas County (Noel).

North America. A weed, introduced from Europe. North Carolina (Rowan County, Small and Heller), Illinois (Hillsboro, Richard), California (Southern California, Parry and Lemmon 407).

General. Western Asia, Siberia and India to Germany and Scandinavia, Great Britain and northern Africa.

2. *AGROPYRON.*

Agropyron Gaertn. Nov. Comm. Petersb. 14: 539. 1770. Benth. Hooker Gen. Pl. 3: 1202. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 78. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 162. f. 130.

Elytrigia Desv. Bull. Philom. 2: 190. 1810.

Roegneria C. Koch. Linn. 21: 413. 1847.

Anthosachne Steud. Syn. Glum. 1: 237. 1855.

Spikelets three to many-flowered, compressed, two-ranked, alternate on opposite sides of a solitary, terminal spike, single at each joint (the lowermost, or all, rarely in pairs) and sessile, with the side against the axis. Glumes transverse (i. e., right and left), nearly equal and opposite, lanceolate, herbaceous, nerved. Flowering glumes rigid, con-

vex on the back, five to seven-nerved, pointed or awned from the tip; palea flattened, bristly-ciliate on the nerves, adherent to the groove of the grain. Stamens 3. (Name from Greek words for *field* and *wheat*.)

KEY TO THE SPECIES OF AGROPYRON.

- A. Culms tufted, no creeping rootstock or stolons.
 - 1. Flowering glumes long-awned.
 - a. Culm stout; spike stout, somewhat one-sided; awn 3-4 times as long as the flowering glume *A. Richardsoni*.¹.
 - b. Culm slender, spike rather slender; awn 1-2 times as long as the flowering glume *A. caninum*.².
 - 2. Flowering glumes awn-pointed or awnless *A. tenerum*.³.
- B. Culms from creeping rootstocks.
 - 1. Flowering glumes glabrous or only scabrous.
 - a. Spikelets compressed, ascending *A. occidentale*.⁴.
 - b. Spikelets narrow, nearly cylindrical, erect.
 - (1) Leaves becoming involute, scabrous on both sides.
..... *A. pseudo-repens*.⁶.
 - (2) Leaves flat, smooth below, pubescent above.
..... *A. repens*.⁷.
 - 2. Flowering glume pubescent *A. occidentale* var. *molle*.⁵.

1. AGROPYRON RICHARDSONI.

Agropyron Richardsoni Schrad. Linnæa 12: 467. 1838. (fide Kew Index.)
Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 301. f. 57. 1899. Shear.
Bull. U. S. Dept. Agr. Div. Agros. 4: 29. 1897.

Agropyron caninum (L.) R. and S. Nash in Britton and Brown. Ill.
Fl. 1: 228 (in part.)

Agropyrum unilaterale Cassidy. Bull. Colo. Agr. Exp. Sta. 12: 63.
1890.

Agropyrum violacescens Beal. Grasses of N. A. 2: 635. 1896.

DESCRIPTION.

RICHARDSON'S WHEAT GRASS. An erect, smooth perennial, 3 to 4 feet (6-8 dm.) high, with rather rough, involute, pointed leaves, and erect, usually one-sided, bearded spikes, 14 to 20 inches (7-10 cm.) long. Spikelets three to four, with long-awned, flowering glumes 4 to 4½ lines (8-9 mm.) long. Dry soil. June to September.

Considered a good forage plant.

DISTRIBUTION.

Iowa. Armstrong 3269 and 3264 (Pammel); Ames. (Sirrinc, Stewart (679 Combs and Ball); Ontario 3274 (Faurot); Armstrong (Cratty); Cedar Falls (Carver); Milford (Shimek).



FIG. 222. *Agropyron Richardsoni*. a. glumes. b. spikelet. (Div. Agros. U.S. Dept. Agrl.)

North America. Minnesota (St. Croix, Parry), South Dakota to the Saskatchewan and British Columbia; in the Rocky Mountains of Colorado and the Uintah Mountains of Utah (Duchesne River 241, East Provo Canon, alt. 8000 ft., East Lake Fork, West Bear Lake, 254 Pammel), Rocky Mountains (Hall and Harbour 656), Wyoming (Burnt Fork 244).

2. AGROPYRON CANINUM.

Agropyron caninum R. and S. Syst. 2: 756. 1817. Watson and Coulter. Gray. Man. Bot. 672. 1890. (6 ed.)

Agropyrum caninum Reichenb. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 123. f. 179. 1894.

Agropyron caninum (L.) Beauv. Beal. Grasses of N. A. 2: 639. 1896.

Agropyron caninum (L) R. and S. Nash in Britton and Brown. Ill. Fl. 1: 228. f. 528. 1896. (in part.)

Agropyrum caninum Beauv. Shear. Bull. U. S. Dept. Agrl. Div. Agros. 4: 29. 1897.

Agropyrum caninoides Beal. Grasses of N. A. 2: 640. 1896.

DESCRIPTION.

AWNED WHEAT GRASS. A rather slender grass, 1 to 3 feet (2-6 dm.) high, with no creeping root-stock. Sheaths smooth, or the lower hairy; ligule short; leaf-blade flat, pubescent above, smooth below.



FIG 228. *Agropyron caninum*—a, empty glumes; b, flowering glume. (Charlotte M. King)



FIG. 224. *Agropyron tenerum*—a, empty glumes; b, flowering glumes, with flowers. (Div. Agros. U. S. Dept. Agrl.)

Spikes more or less nodding, 3 to 6 inches (6-12 cm.) long. Spikelets three to six-flowered, the florets rather distant; empty glumes three to five-nerved, acute or long awned; flowering glumes nerved near the tip, with awns nearly twice their length. July-August.

Reported from northwestern Iowa only, where it is not uncommon. The species is considered a good forage plant.

DISTRIBUTION.

Iowa. Ames 38 and 769 (Ball and Combs); Iowa-Minnesota line (Pammel); Ames (Sirriner); Emmet County (Cratty); Lake Okoboji (Hitchcock).

North America. From New Brunswick, Saskatchewan and British Columbia, south to Colorado; south through New England and middle states and west to Nevada, Wyoming (Sheep Mountain, T. A. Williams 2306).

General. Europe and Asia.

3. AGROPYRON TENERUM.

Agropyron tenerum Vasey. Bot. Gaz. 10: 258. 1885. Watson and Coulter. Gray. Man. Bot. 672. 1890. (6 ed.) Shear. Bull. U. S. Dept. Agrl. Div. Agros. 4: 29. 1897. Nash in Britton and Brown. Ill. Fl. 1: 227. f. 527. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 297. f. 593. 1899.

Agropyron repens var. *tenerum* Vasey. Beal. Grasses of N. A. 2: 636. 1896.

DESCRIPTION.

SLENDER WHEAT GRASS. An erect, caespitose, rather stout, smooth perennial, 3 to 4½ feet (6-9 dm.) high, with narrow, flat leaves, and slender, cylindrical spikes, 4 to 7½ inches (8-15 cm.) long. Outer glumes five-nerved; flowering glumes lanceolate, 4 to 5 lines (8-10 mm.) long, tipped with a stiff, straight awn ½ to 2 lines (1-4 mm.) long. Dry soil. July-August.

It has been found in eastern, northern and northwestern Iowa, but native only to northwestern Iowa, from Emmet to Lyon counties. It is a valuable forage plant and highly esteemed in the Rocky Mountains. In Iowa it starts early in the spring and matures very rapidly. See figure 224, on page 317.

DISTRIBUTION.

Iowa. Mason City (Miss King), 895 Elmore, Minn. (Minnesota-Iowa line), 3366 and 3307 Ceylon, 3362 and 3360 Spirit Lake (Pammel); Cedar Falls (Carver); Ames 1117 (Stewart, Carver, Sir-

rine); 3344 Marathon (Roberts); 3184 Elgin (Patterson); Emmet County, Armstrong (Cratty); Lyon County (Macbride); Rock Rapids, Spirit Lake (Shimek); Ames (Bessey).

North America. Minnesota, Nebraska (Ravenna and Grand Island, Pammel), Colorado (Colorado Springs, Pammel; Ft. Collins, Crandall 49; Rouatt County, Shear and Bessey 1393), New Mexico, Utah (East Duchesne River 235, Pammel and Stanton; Salt Lake City and White Rock Agency, Pammel and Stanton; Black's Fork and Echo, Pammel, Johnson, Buchanan and Lummis, 1573, 1578, 1581 and 1582), Wyoming (Snake River, A. & E. Nelson, Burnt Fork and Sheridan, 246, 247, Pammel and Stanton), Washington (Sandberg and Leiberger 331).

4. AGROPYRON OCCIDENTALE.

Agropyron occidentale Scribner. N. Sp.

Agropyrum spicatum (Pursh.) Scribn. and Smith. Bull. U. S. Dept. Agrl. Div. Agros. 3: 12. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 298. f. 594. 1899.

Agropyrum spicatum Scribn. and Smith. Shear. Bull. U. S. Dept. Agrl. Div. Agros. 4: 33. 1897.

DESCRIPTION.

COLORADO BLUE STEM. WESTERN WHEAT GRASS. A rigid, upright, glaucous perennial, 1 to 4 feet (3-12 dm.) high, from creeping root-stocks, with rather firm, bluish-green leaves, and straight, beardless spikes, 3 to 7 inches (6-14 cm.) long. Spikelets seven to thirteen-flowered, 6 to 10 lines (12-20 mm.) long, with lanceolate, acuminate-pointed, empty glumes, and acute flowering glumes 4 to 6 lines (8-12 mm.) long. Dry or moist soil. June to September.

This species is widely introduced in Iowa, especially east of the Missouri divide, except in Emmet, Palo Alto and Cerro Gordo counties, where it is native. The Wisconsin localities are most likely from introduced plants. It is one of the most abundant grasses of the plain west of the Missouri river and east of the Rocky Mountains. It covers wide stretches of the western plains forming a considerable part of the herbage. It is a most valuable forage grass for the west. In many parts of Iowa and Minnesota it is becoming a troublesome weed, spreading with as much rapidity as quack grass.

DISTRIBUTION.

Iowa. 663 Denison, Mason City, 392 Elmore, Minn., Iowa-Minnesota line, 3308 Ceylon, 3268 Armstrong (Pammel); Ames (Carver,



FIG. 225. *Agropyron occidentale*—a, empty glumes; b, flowering glumes with flowers. (Div. Agros. U. S. Dept. Agrl.)



FIG. 226. *Agropyron occidentale* var. *molle*—a, spikelet; b, d, flowering glume; c, palea and anther; e, empty glumes. (Div. Agros. U. S. Dept. Agrl.)

Stevens, C. A. Wilson, Sirrine, P. H. Rolfs); Harcourt (Danielson); Hamilton County (P. H. Rolfs); 3190 Hampton (Peck); 3292 Afton Junction (Miller); 3275 Ontario (Faurot); 377 Macedonia. (Stempel); 1128 Alden (Stevens); 305 Pilot Mound (Miss King and MacCorkindale); 951 Battle Creek (Preston); Twin Lake Township, Calhoun County (Rigg); Mason City (Shimek); Hedrick (J. T. Brooks); Emmet County (Cratty); Farragut, Spirit Lake, Forest City, Rock Rapids (Shimek); Nora Springs (Gaylord); Milford (Shimek); Ft. Dodge (Oleson).

North America. Minnesota (Vernon Center, Pammel 2), Kansas, Nebraska (McCook 219, Aurora 55, Alma 56, Pammel), Colorado (Ft. Collins, Crandall; Malta, Pammel and Stanton 225; Palmer Lake Pammel), Wyoming (Burnt Fork, Pammel and Stanton; Piedmont, Pammel; Pine Bluff, Pammel, Johnson, Lummis and Buchanan), Texas, Utah (Salt Lake City and Echo, Pammel, Johnson, Buchanan and Lummis; White Rock Agency and Provo River, Pammel and Stanton; Black's Fork, Pammel; Southern Mt., Siler) and Arizona; north to Montana and Saskatchewan.

5 AGROPYRON OCCIDENTALE VAR. MOLLE. PAMMEL. NOV. COMB.

Agropyron spicatum molle Scribner and Smith. Bull. U. S. Dept. Agrl. Div. Agros. 4: 33. 1897.

DESCRIPTION.

SOFT WESTERN WHEAT GRASS. Culms 1 to 4 feet high, with compressed, acute spikelets; culms rigid, erect and striate; leaves roughish on the margins, brown nodes; sheaths striate, smooth, shorter than the internodes; ligule short; blades erect, separating, rigid, bluish green; scabrous on the margins and along the prominent nerves. Spikes exerted 3 to 7 inches (7-20 cm.) long. Spikelets pedicellate, greenish, $\frac{1}{2}$ to 1 inch ($1\frac{1}{2}$ -3 cm.) long; empty glumes and rachis more or less villous and pubescent, lanceolate, acuminate, scabrous on the nerves. Flowering glume 4 to 6 lines (8-12 mm.) long, narrowly lanceolate, acute or acuminate; palea a little shorter than the flowering glume. See figure 226, on page 320.

DISTRIBUTION.

Iowa. Ontario (F. W. Faurot 3274). Introduced.

North America. The Saskatchewan to Colorado and New Mexico, and westward to Idaho and Washington.

6. AGROPYRON PSEUDO-REPENS.

Agropyron pseudo-repens Scribn. and Smith. Bull. U. S. Dept. Agrl. Div. Agros. 4: 34. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 296. f. 592. 1899.

(In the past very frequently it has been referred to as *Agropyron repens* by many American collectors.)

DESCRIPTION.

An erect, rather stout perennial, $1\frac{1}{2}$ to $4\frac{1}{2}$ feet (3-9 dm.) high, from creeping root-stocks, with flat, scabrous leaves, and erect spikes 4 to 8



FIG. 227. *Agropyron pseudo-repens*—a, empty glumes; b, flowering glumes with flowers. (Div. Agros. U. S. Dept. Agrl.)



FIG. 228. *Agropyron repens*—a spikelet; b, parts of spikelet displayed, two empty glumes. (Div. Agros. U. S. Dept. Agrl.)

inches (8-16 cm.) long. Spikelets 5 to 8 lines (10-16 mm.) long, three to seven-flowered, with linear-lanceolate, nearly equal and five-nerved empty glumes, with acuminate or awn-pointed flowering glumes. Rather moist soil. May to September.

This species is local in north central and northwestern Iowa. In the Rocky Mountains it is considered a valuable forage grass.

DISTRIBUTION.

Iowa. Granite (Shimek); Ogden (Pammel).

North America. Ontario to Wisconsin, Minnesota, Iowa, Nebraska (Grand Island and Broken Bow 54, Pammel), and the Rocky

Mountain region Colorado (Steamboat Springs, Shear and Bessey), Wyoming (Sheridan County, Big Goose Creek, Pammel, Stanton and Crone; Bear River, Pammel, Johnson, Buchanan and Lummis 1635, and 1634), Utah (Burnt Fork, Provo River, Bear River 255, Pammel and Stanton); Black's Fork, Pammel, Johnson, Buchanan and Lummis 969), Texas and Arizona to British Columbia.

7. AGROPYRON REPENS.

Agropyron repens Beauv. Agros. 146. 1812. Watson and Coulter. Gray. Man. Bot. 671. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 123. f. 178. 1894. Shear. Bull. U. S. Dept. Agrl. Div. Agros. 4: 35.

Agropyron repens (L.) Beauv. Beal. Grasses of N. A. 2: 636. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 304. f. 298. 1900. (3ed).

DESCRIPTION.

COUCH GRASS, QUACK GRASS. Culms 1 to 3 feet (2-6 dm.) high, from an extensively creeping, jointed rootstock. Sheaths striate, usually smooth; ligule very short; leaves 4 to 12 inches (8-24 cm.) long, smooth, scabrous, or sometimes pubescent above. Spikes 3 to 10 inches (6-20 cm.) long, erect. Spikelets four to eight-flowered; empty glumes five to seven-nerved, obtuse or notched, acute or short-awned; flowering glume nerved near the apex, awnless or sometimes short-awned. June to September. See figure 228, on page 322.

Naturalized in lawns, waysides and cultivated ground. Becoming a troublesome weed in many sections of the state. The species furnishes good forage, but its weedy nature should prevent its introduction as a forage plant.

DISTRIBUTION.

Iowa. Ames 153 (Ball); Macedonia 376 (Sample), Boone (Carver); Decorah 3189 (Jacobson); Ames (Rolfs); Creston (Stewart); Ames 1150 (Louthan); Alden 1133 (Stevens); Ames (Hodson); Hamilton County (Rolfs); Waverly (Erwin); Northwood (Tenold); Ames (Sirrinc); Rock Rapids (Shimek); Jewell Junction (Carver); Grundy Center (Miss Paddock); Keokuk (Shimek); Iowa City (Hitchcock); Delaware County (Cameron); Ames (Bessey).

North America. Widely naturalized in North America. From Maine to British Columbia, New York (Parry), Connecticut (Glastonbury, Frances Wilson), Wisconsin (La Crosse, Pammel, 3231), Nebraska, Dakotas, Missouri, Colorado and the Gulf states.

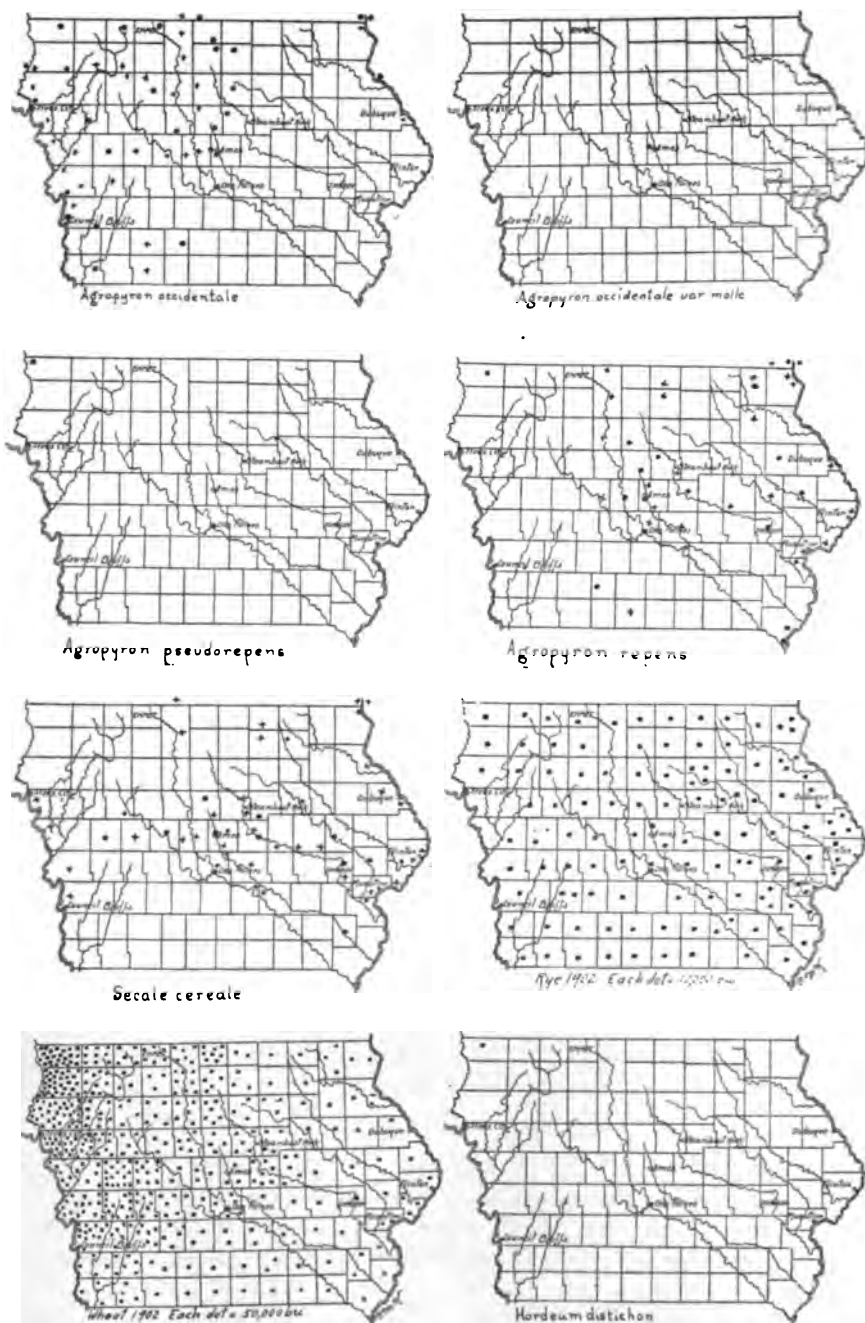


FIG. 229. Distribution of *Agropyron*, *Secale* and *Hordeum*.
 ●Specimens in herbarium. †Localities observed.

General. Great Britain, the continent of Europe, Scandinavia to northern Africa, northern Asia and the Himalayas.

3. SECALE.

Secale L. Sp. Pl. 84. 1753. Endlicher. Gen. Pl. 103. Bentham and Hooker. Gen. Pl. 3: 1203. Beauv. Agros. 105. *pl.* 10. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 163 *f.* 131. (Rev. ed.)

Spikelets two, rarely three-flowered, solitary and sessile at the notches of the rachis, forming a spike; rachilla produced above the florets into a slender stipe. Empty glumes two, rigid, narrow, acuminate or subaristate-pointed; flowering glume broader, compressed-keeled, five-nerved, awned from the point; palea a little shorter than the glumes, two-keeled. Stamens 3. Styles very short, distinct; stigmas plumose. Grain oblong, sulcate, pilose at the apex, free. Annual grasses, with flat leaves, and dense, terminal spikes, the rachis of which is usually articulated.

Two species, the *Secale cereale* and *S. fragile*, both native of the Old World. The original species of *S. cereale* known as *S. montanum* Guss, grows upon the mountains of Spain and Morocco, through Siberia to Asia Minor and central Asia.

1. SECALE CEREALE.

Secale cereale L. Sp. Pl. 84. 1753. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 124. 1894: Beal. Grasses of N. A. 2: 640: 1896.

DESCRIPTION.

RYE. An annual grass, 4 to 6 feet (10-15 dm.) high, with linear-lanceolate leaves, and terminal, somewhat flattened, linear, bearded spikes, 4 to 6 inches (8-12 cm.) long. Culms simple, erect, hairy near the spike; sheaths striate, smooth; ligule short, dentate; leaf-blade smooth on the lower surface, scabrous on the upper surface and margins. Empty glumes linear-subulate, nearly equal, scabrous, bristly-pilose at the base; flowering glumes ventricose, acuminate, compressed near the apex, and terminating in a long, scabrous awn.

DISTRIBUTION.

Iowa. 3207 Conrad (Miss E. Paddock); Ames (Weaver, 1146 Louthan, Stewart, E. R. Wilson); Spring Hill (Jones); Mt. Pleasant (Mills); Marshalltown (Eckles); Cedar Rapids (Miss Hall); Durant 1135 (Weaver); Ames (Mast, Carver, Fairfield); Denison 674, Webster City, Jefferson (Pammel); Johnson County (Cratty).

North America. Widely naturalized, or in a semi-naturalized condition from the Atlantic to the Pacific.

General. Generally cultivated in Europe, the original form native to the mountains of southern Europe.

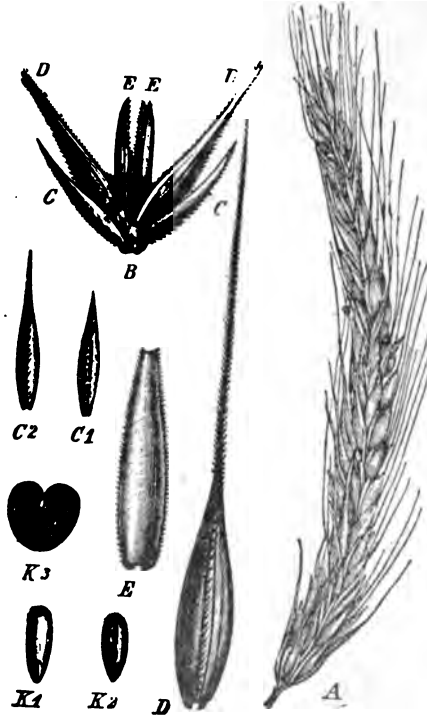


FIG. 230. *Secale cereale*—a, spike; b, spikelet; d, awned flowering glume; e, palea; k1, k2, k3, views of seed. (Hackel.)

4. TRITICUM.

Triticum L. Sp. Pl. 85. 1753. Endlicher Gen. Pl. 103. Bentham and Hooker. Gen. Pl. 3: 1204. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 80. f. 93-102. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 20: 164. f. 132. (Rev. ed.)

Spikelets two to five-flowered, solitary and sessile at the joints of the rachis, forming dense, terminal spikes; rachilla articulated between the florets; lower flowers in each spikelet hermaphrodite, the upper staminate or imperfect. Empty glumes at the base of the spikelet two, rigid, usually shorter and narrower than the flowering glumes, short-awned or

awnless; flowering glumes oblong, ventricose or rounded on the back, sometimes keeled above, five to nine-nerved, awned or awnless; palea two-keeled, keels ciliate. Stamens 3. Style very short; stigmas plumose. Grain ovoid or oblong, sulcate, hairy at the apex, free or adherent to the palea. Annual, erect grasses with terminal, cylindrical spikes.

There are twelve species of *Aegilops* native to southern Europe and Asia; one species, the *Aegilops ovata*, occurs in southern Europe. There are three species of the section *Sitopyros*.



FIG. 231-a.

a—1, English Wheat. *Triticum sativum turgidum*; 2, Flint Wheat. *Triticum sativum durum*. (Hackel.)



FIG. 231-b.

b—1, Common Bearded Winter Wheat. *Triticum sativum vulgare*; 2, *Triticum sativum vulgare muticum*. (Hackel.)

1. TRITICUM VULGARE.

Triticum vulgare Vill. Hist. Pl. Dauph. 2: 153. Beal. Grasses of N. A. 2: 642. f. 122. 1896.

Triticum sativum Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 124. 1894.

DESCRIPTION.

WHEAT. An annual, with terete, simple culms, 2 to 5 feet (5-14 dm.) high. Leaves narrowly lanceolate, striate, usually scabrous on the upper surface. Sheaths striate, smooth; ligule short, truncate. Spike 3 to 6 inches (7-14 cm.) long, dense, four-sided, axis compressed, rather



FIG. 232-a.

a—1, Polish Wheat. *Triticum Polonicum*; 2, Bearded Spelt. *Triticum sativum Spelta* (Hackel.)

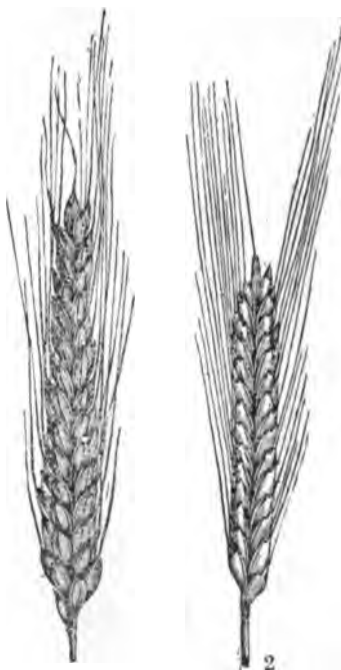


FIG. 232-b.

b—1, German Wheat. *Triticum sativum dicoccum*; 2, One-grained Wheat. *Triticum monococcum*. (Hackel.)

broad, margins hirsute; spikelets broadly obtuse, three to five-flowered; glumes ventricose, obtuse, mucronate or awned.

Wheat is grown in all parts of the state. Winter wheat succeeds best in southern and eastern parts of the state; summer wheat in north-western Iowa.

DISTRIBUTION.

Iowa. Ames (Fairfield, Stewart, Weaver, Pammel, Sirrine, Carver); Boone (Carver); 1123 and 1171 (Alden (Stevens)).

General. Wheat is widely cultivated in temperate regions of the old and new worlds. Cultivated in Europe in prehistoric times. Its original home is western Asia.

5. HORDEUM.

Hordeum L. Sp. Pl. 84. 1753. Endlicher. Gen. Pl. 104. Bentham and Hooker. Gen. Pl. 3: 1206. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 165. f. 133.

Critho E. Mey. Ind. Hort. Region. 1848.

Ziocriton Beauv. Agrost. 114. 1812.

Critesion Raf. Jour. Phys. 89: 103. 1819.

Spikelets one-flowered, with an awl-shaped rudiment on the inner side, three at each joint of the rachis of a terminal spike. The lateral ones usually imperfect or abortive, and short-stalked. Empty glumes side by side, in front of the spikelets, six in number, forming a kind of involucre, slender and awn-pointed, or bristle-form. Flowering glume and pale herbaceous, the former (anterior) convex, long-awned from the apex. Stamens 3. Grain oblong, commonly adherent. Spike often separating into joints. Ours annuals or biennials, or scarcely perennial. (The ancient Latin name.)

Hackel recognizes sixteen species of *Hordeum*, although Bentham & Hooker only give twelve. The species occurs in temperate Asia, Europe, Africa and North and South America; of the sixteen species Beal records eight for the United States; but Scribner and Smith¹ record ten species in 1897. Several species have been added since then; it is probable, however, that the number of species will be somewhat reduced.

KEY TO THE SPECIES OF HORDEUM.

- A. Lateral spikelets sessile (cultivated species).
 - 1. Flowers in the lateral spikelets sterile, making the fruiting spike appear distichous.....*H. distichon*.¹.
 - 2. Flowers in the lateral spikelets fertile, the fruiting spike appearing six-rowed*H. vulgare*.².
- B. Lateral spikelets raised on a short pedicel.
 - 1. Empty glumes all alike, subulate.
 - a. Floret of the lateral spikelets rudimentary, awnless, or short-awned.
 - (1) Awn of the flowering glume in the central spikelet 2.5-6 mm. long.....*H. jubatum*.³.
 - (2) Awn of the flowering glume of the central spikelet less than 1.5 cm. long.....*H. nodosum*.⁴.
 - b. Flower of the very short-pedicelled, lateral spikelets fertile; awn about 2 cm. long.....*H. Pammeli*.⁵.
 - 2. Empty glumes of the middle spikelets, and the inner empty glumes of the lateral spikelets dilated above the base...*H. pusillum*.⁶.

1. HORDEUM DISTICHON.

Hordeum distichon L. Sp. Pl. 185. 1753. Beal. Grasses of N. A. 2: 647.



FIG. 233. Left, *Hordeum distichon*; right, *Hordeum vulgare* var. *trifurcatum*: a, trifurcate scale. (Charlotte M. King.)

DESCRIPTION.

TWO ROWED BARLEY. Two to three feet (6-9 dm.) high, spikes strongly compressed laterally, the sterile, lateral spikelets appressed to the rachis, with or without stamens. Spikelets nodding or upright.

DISTRIBUTION.

Iowa. Lyon County (Shimek).

North America. Cultivated in northern United States.

General. Cultivated in Europe and Asia, and temperate regions generally.

2. HORDEUM VULGARE.

Hordeum vulgare L. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 125. 1894.

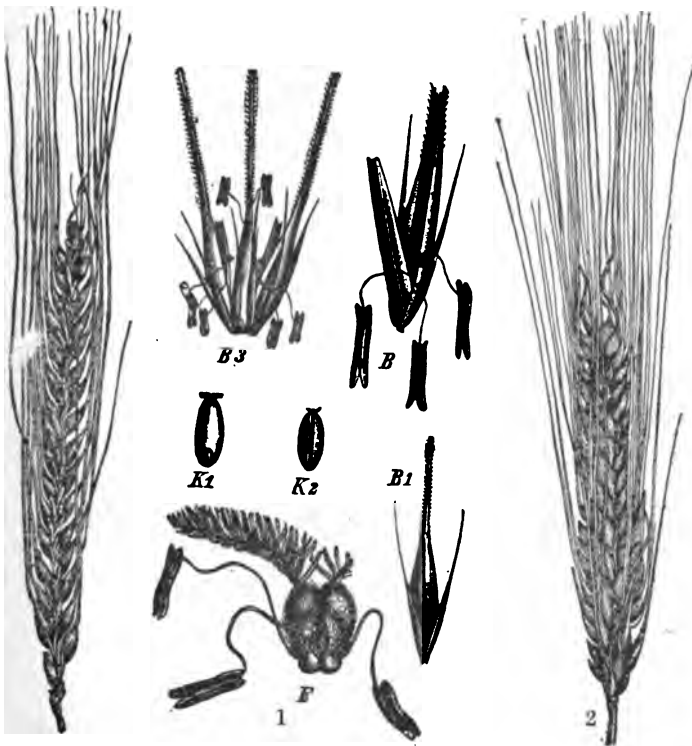


FIG. 284. Left, two-ranked barley; *Hordeum distichon*. Right, common four-rowed barley; *Hordeum vulgare*; b, b1, b3, spikelet; k1, fruit; f, pistils and stamens. (Hackel.)

DESCRIPTION.

FOUR ROWED BARLEY. Annual, 2 to 3 feet (4-7 dm.) high, smooth. Leaves linear-lanceolate, keeled, nearly smooth; sheaths striate, smooth, auricled at the throat; ligule very short. Spikes 3 to 4 inches (6-9 cm.) long, somewhat four-sided, rachis flattened, pubescent on the margins. Spikelets with one perfect floret; empty glumes, narrowly linear, pubescent, terminating in a slender awn; flowering glume five-nerved, scabrous near the apex, long-awned; awn flattened, keeled, somewhat three-nerved, serrulate on the margins.

DISTRIBUTION.

Iowa. Alden (Stevens); Ames (E. R. Wilson, P. H. Rolfs); Jefferson (Stewart); Story City (Pammel and Stewart).

North America. This cereal is without doubt one of the most ancient of cultivated plants. It is supposed to have originated from *H. spontaneum* Koch which grows wild in Asia Minor and Caucasian countries to Persia and Beloochistan as well as Syria and Palestine.

3. HORDEUM JUBATUM.

Hordeum jubatum L. Sp. Pl. 85. 1753. Watson and Coulter. Gray. Man. Bot. 672. *pl.* 11. 1890. (6 ed.) Beal. Grasses of N. A. 2: 644. 1896. (2 ed.) Nash in Britton and Brown. Ill. Fl. 1: 229. *f.* 531. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 307. *f.* 603. 1899.

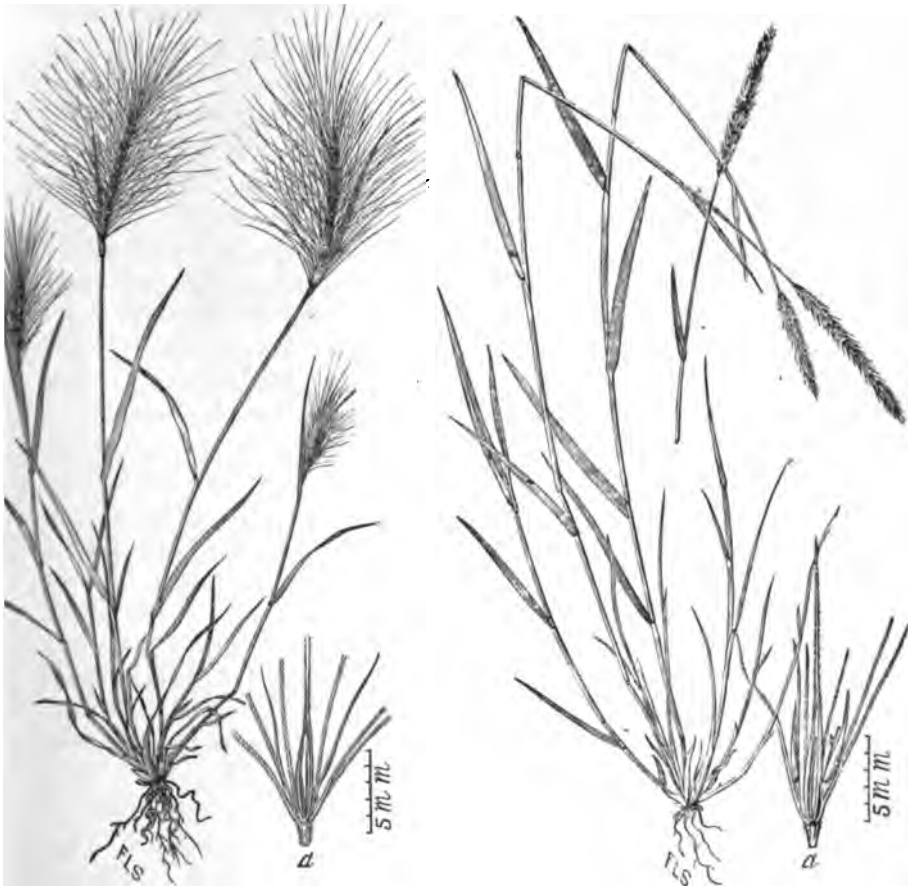
DESCRIPTION.

SQUIRREL TAIL GRASS. A smooth, slender and erect, annual or biennial (perennial?), 1 to 2 feet (2-4 dm.) high, with flat leaves, and long, bearded, nodding spikes, 2½ to 5 inches (5-10 cm.) long. Empty glumes awn-like, 1½ to 2½ inches (3-5 cm.) long, the flowering glume of the central spikelet 3 to 4 lines (6-8 mm.) long, terminating in a slender awn 1½ to 2½ inches (3-5 cm.) long. Moist, saline soils. June to August.

Squirrel tail grass is widely distributed in Iowa; reported from nearly every county. A most troublesome weed in pastures. See figure 235, on page 333.

DISTRIBUTION.

Iowa. Forest City (Shimek); Missouri Valley, 885 Elmore, Minn., Iowa-Minnesota line, Eagle Grove, 896 Ledyard, Jefferson, Logan, 659 Missouri Valley, Carroll, Council Bluffs, 1307 Council Bluffs, Ames, Dakota City, 3218 Clinton, Webster City, South Dakota



235. *Hordeum jubatum*—a, spikelet. (Div. Agros. U. S. Dept. Agrl.) FIG. 236. *Hordeum nodosum*—a, spikelet. (Div. Agros. U. S. Dept. Agrl.)

opposite Hawarden (Pammel); Le Claire (F. Rolfs); Ames (C. A. Wilson, Bessey, Beardslee, Reynolds, Taylor, 1154 Louthan, Hitchcock, 1165 Stewart, Miss Gaylord, Carver); Rock Rapids, Mason City (Shimek); Calhoun County (Rigg); Pottawattamie County (Cameron), Newton (Misses Cavanagh and Dilne); Muscatine (Reppert); Greenfield (Stewart); Sioux City (Miss Wakefield); 1072 Emmet County (Cratty); Taylor County 1114 (Pool); Battle Creek 953 (Preston); Mason City (Parker); Clinton (Ball); 3248 Beaver (Pammel and Kinzer); Grundy Center, 3251 (Miss Paddock); 3277 Ontario (Faurot); 3334 Marathon (Roberts); 3212 Calmar Junction (Pammel); 1 Ames (Ball); Harcourt (Danielson); Wheatland

(Ball); 699 Amana (Schadt); Mt. Pleasant (Mills, Witte); Marshalltown (Stewart); Iowa City (Hitchcock); Keokuk (P. H. Rolfs); Jewell Junction (Carver); Colfax (Mead); Manly (Williams); Dysart, Benton County (Miss Sistine); 840 Boone (Steele); 837 Charles City (Anderson); Belknap (Rankin); Keystone (Koch); High Bridge, Dallas County (Shimek); Des Moines (Pammel); Milford (Skiff); Oskaloosa (White).

"Greenfield (Stewart); Corning (Bixby); Postville (Williams); Rossville (Wiley); Centerville (Reister); Shellsburg (Budd); Belle Plaine (Van Dyke); Cedar Falls (Speer); Madrid (Heaton); Rowley (Herman); Rockwell City (Heaton); Dedham (Kay); Coon Rapids (Kay); Atlantic (Franklin); Mechanicsville (Hubbard); Clear Lake (Carpenter); Mason City (Nettleton); Larrabee (Strever); New Hampton (Gabrilsen); Lawler (Obyrne); Hopeville (Ashley); Clinton (Roberts); Belknap (Parker); Bloomfield (Duffield); Garden Grove (Wemple); Hawkeye (Bopp); Hampton (Grenelle); Geneva (Thompson); Hamburg (Rice); Enfield (Jefferson); Casey (Benedict); Iowa Falls (Parmelee); Williams (Fuller); Mt. Pleasant (Wright); Cresco (Marshall); Humboldt (Wells); Battle Creek (Preston, Crowley); South Amana (Schadt); Newton (Beatty); Lake Mills (Keeler); Decatur County (Shimek); Unity (Hummer); What Cheer (Lawrence); Mooar (Thomas); Wapello (Miller); Chariton (Burr); Little Rock (Ball); Winterset (Kinsman); Oskaloosa (Boyd); Marshalltown (Eckles); Mapleton (Lamb); Villisca (McCartney); Shenandoah (Mollison); Neola (Humesworth); Council Bluffs (Williams); Grinnell (Price); Sac City (Brown); Ames (Mills); Traer (Wilson); Lenox (Hurley); Pittsburg (Duffield); Wilsonville (Taylor); Seymour (Wagner); Ft. Dodge (Blaine); Forest City (Secor); Sioux City (Purcell and Skinner); Iowa City, Davenport (Shimek); Hamilton to Hancock County (Preston); Onslow (Cameron)." Localities based on reports.

North America. Moist, saline soils, Canada, the United States south to Illinois (Venice, Eggert; Chicago, Pammel); Minnesota (Thompson, Sandberg 420), South Dakota (Brookings, Halsted), Wisconsin (La Crosse, D. S. Pammel); Nebraska (Oxford, Aurora 22; Broken Bow 106, Alma, Hastings, Pammel), Kansas, Colorado (Laimer County, Fort Morgan, Silver Plume, Pammel; Ft. Collins, Crandall; New Windsor, Osterhout, 2380; Petersburg, Lummis 1561); Utah (Cache la Poudre River, 8000 ft., Pammel; Echo, Pammel); Johnson, Lummis and Buchanan), Wyoming (New Castle, Sherman);

Sheridan County, Pammel; Yellowstone National Park, A. and E. Nelson; Dale Creek, Pammel, Johnson, Buchanan and Lummis; New Mexico (Vasey), Nevada (Montella, Pammel), Idaho (Sandberg), and California.

General. Europe and Siberia.

4. HORDEUM NODOSUM.

Hordeum nodosum L. Sp. Pl. 56. (2ed.) 1762. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 313. f. 609. Nash in Britton and Brown. Ill. Fl. 1: 228. f. 529.

DESCRIPTION.

WILD OR MEADOW BARLEY. A slender, erect, caespitose grass, $\frac{2}{3}$ to 2 feet (2-6 dm.) high, with flat leaves, and narrow, bearded spikes, $\frac{2}{3}$ to 3 inches (2-8 cm.) long. Empty glumes all setaceous or awn-like; lateral spikelets imperfect. Awns 3 to 6 lines (6-12 mm.) long. May to August. See figure 236, on page 333.

DISTRIBUTION.

Iowa. Hawarden; Lyon County.

North America. Indiana and Minnesota to Alaska, and south to Tennessee, Mississippi, Texas and California.

General. Europe and Asia.

5. HORDEUM PAMMELI.

Hordeum Pammelii Scribner and Ball. n. sp.

DESCRIPTION.

PAMMEL'S WILD BARLEY. A caespitose, glabrous perennial, erect or somewhat geniculate at the base, 6 to 10 dm. high. Sheaths smooth, shorter than the internodes; ligule a scarious ring about .5 mm. long; blades flat, linear-lanceolate, 5 to 8 mm. wide, 1.2 to 2 dm. long, minutely retrose-scabrous on both surfaces, long-acuminate at the apex. Spikes exserted, nodding, long and slender, 8 to 17 cm. long and 6 to 8 mm. wide, excluding the awns, or 2 to 3 cm. wide with the awns. Joints of the rachis about 2.5 mm. long, scabrous, articulated, separating at maturity. Spikelets three at each joint, ascending or somewhat appressed, the central sessile, the lateral ones nearly so, on very short pedicels, less than .5 mm. in length, all containing fertile flowers, the central three-flowered, the lateral two-flowered, the uppermost flower in

each case being rudimentary. Empty glumes subulate, one to two-nerved, minutely scabrous, produced into a long, slender, scabrous awn, glume with awn 2.3 to 3.5 cm. long. Flowering glume of the lower flower of the central spikelet 7.5 to 8.5 mm. long, on a very short stipe, smoothish at the base, becoming scabrous and indistinctly three to five-



FIG. 237. *Hordeum Pammelt*—a, group of three spikelets; b, central spikelet; c, florets of central spikelet; 1 and 2, parts of fertile flower of central spikelet; 3 and 4, parts of staminate flower; 5, rudimentary flower; d, lateral spikelet; 1 and 2, parts of fertile flower of lateral spikelet; 3 and 4, rudimentary flower. (Charlotte M. King.)

nerved toward the minute, bicuspidate apex, topped with a slender, scabrous awn 2.3 to 3.5 cm. long. Second flower shorter, 6 to 7 mm. long, awn 7 to 15 mm. long. Rudimentary flower about 4 to 5 mm. long, acuminate, joints of the rachilla about 1.5 mm. long. Floret of lateral

spikelets about 7 mm. long, on a stipe 1 mm. long; awn 1.2 to 2 cm. long. Palea as long as their florets, scabrous on the keels.

Type collected at Dakota City, Iowa, by L. H. Pammel, No. 3824, August 8, 1896 prairies along the line of the C. & N. W. R. R.

In the genus *Hordeum* the spikelets are one-flowered, with a rudimentary second flower usually present. *H. Pammeli* is unique in having the central spikelet normally two-flowered, with a rudimentary third flower but is still referable to *Hordeum* rather than to *Elymus*. It resembles in general appearance *H. caespitosum* or a very large form of *H. nodosum*. It is readily distinguished from all other species by the short-stalked or nearly sessile, lateral spikelets, containing a fertile flower. These characteristics show it to be closely related to the common cultivated barley. See figure 237, on page 336.

DISTRIBUTION.

Iowa. Dakota City (Pammel).

North America. Central Illinois to northwestern Wyoming, in moist situations, sometimes shaded. Apparently rare, and of local distribution, though reported as common in the Wyoming locality. Latter part of June to middle of August.

There are three other collections of this species. Illinois: Wady Petra, NW $\frac{1}{4}$, Sec. 31, Valley Township, Stark County, moist bank of ditch V. H. Chase, 45, June 25, 1897, *sub nomen Elymus striatus* Willd. This was examined in the herbaria of Mrs. Agnes Chase, Washington, D. C., Prof. S. M. Tracy, Biloxi, Miss., and the Field Columbian Museum, Chicago. South Dakota: Brookings, E. N. Wilcox, 68, July 8, 1896. Wyoming: Hulett, moist, shady meadow, common, David Griffiths 930, July 17, 1898. The last two specimens are in the herbarium of the office of the Agrostologist, U. S. Department of Agriculture.

6. HORDEUM PUSILLUM.

Hordeum pusillum Nutt. Gen. 1: 87. 1818. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 125. f. 181. 1894. Nash in Britton and Brown. Ill. Fl. 1: 229. f. 530. 1896. Bull. U. S. Dept. Agrl. Div. Agros. 17: 314. f. 610. 1899.

Hordeum pratense Huds. Watson and Coulter. Gray. Man. Bot. 672. (6 ed.) Beal. Grasses of N. A. 2: 645. f. 123. 1896.

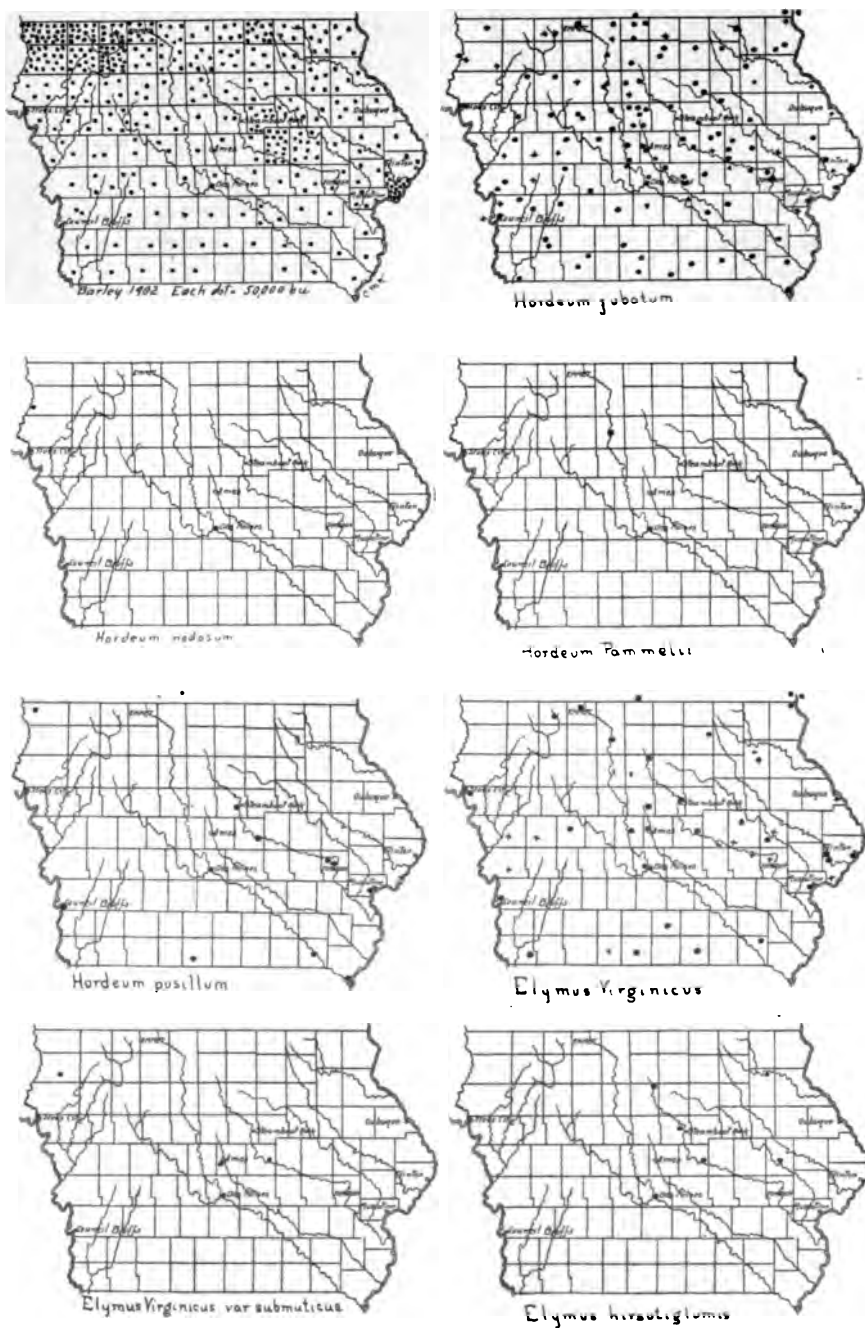


FIG. 238. Distribution of *Hordeum* and *Elymus*.
 ● Specimens in herbarium. † Localities observed.



FIG. 239. *Hordeum pusillum*—a, group of spikelets; b, central spikelet. (Div. of Agros. U. S. Dept. Agri.)



FIG. 240. *Elymus Virginicus*—One of the spikelets shown to the left. (Div. Agros. U. S. Dept. of Agri.)

DESCRIPTION.

LITTLE BARLEY. An annual, 4 to 10 inches (8-21 cm.) high. Culms more or less geniculate at the lower nodes. Sheaths smooth, the uppermost often inflated and enclosing the base of the spike; leaf-blade 1 to 3 inches (2-7 cm.) long, usually a little pubescent on the lower surface. Spikes narrow, 1 to 3 inches (2-7 cm.) long. Empty glumes rigid, the four internal ones of each group dilated above the base, those of the central spikelet sublanceolate, all awn-pointed; outer glumes of the imperfect, lateral spikelets setaceous. Flowering glume of the central spike-

let awned; awn equalling those of the empty glumes. Florets of the lateral spikelets awnless, or nearly so. April to August.

Hordeum pusillum is an introduced plant, found at several points in the southern half of the state, from Clinton to Council Bluffs.

DISTRIBUTION.

Iowa. Iowa City (Hitchcock); Marshalltown, Quarry (Ball); Muscatine (Reppert); Council Bluffs, 1361 Ottumwa (Pammel); Decatur County (Fitzpatrick); Johnson County (Macbride, Hitchcock, Shimek); Morning Sun (Carver); Lyon County, Davenport (Shimek); Quarry 15 (Hodson); Steamboat Rock 3193 (Miss King); Iowa City (Hitchcock); Decatur County (Shimek); Keosauqua (Shimek).

North America. From Ontario to British Columbia; south to Illinois (East St. Louis, Eggert), Nebraska (Grand Island, Crete, McCook and Hastings, Pammel), Missouri (St. Louis, Pammel), Kansas (Hitchcock), Texas (Nealley), Arkansas (Harvey), Colorado (Denver and Ft. Collins, Pammel).

6. ELYMUS.

Elymus L. Sp. Pl. 83. 1753. Endlicher Gen. Pl. 103. Bentham and Hooker. Gen. Pl. 3: 1206. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 88. f. 106. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 166 f. 134.

Polyantherix Nees. Ann. Nat. Hist. 1: 1. 284. 1838.

Spikelets two to four at each joint of the rachis of a terminal spike, all fertile and alike sessile, each one to seven-flowered. Glumes conspicuous, nearly side by side in front of the spikelets, two for each spikelet, forming an involucre to the cluster. Flower coriaceous; the glume rounded on the back, acute or awned at the apex. Grain adherent to the involving glume (whence the name, an ancient one for some grain, from the Greek word for *to roll up*).

Bentham & Hooker recognize twenty species, including *Sitanion*, while Hackel recognizes thirty species including the same genus. Beal in his "Grasses of North America" recognizes fifteen species and three varieties.

KEY TO THE SPECIES OF ELYMUS.

- A. Spikes rigid, erect; empty glumes rigid, thick, indurated and strongly curved at the base; awns 6-18 mm. long (or wanting in *E. Virginicus* var. *submuticus*¹).
 - 1. Spikelets glabrous.....*E. Virginicus*¹.
 - 2. Spikelets hirsute.....*E. hirsutiglumis*².

- B. Spikes more or less nodding; empty glumes not thickened or curved at base, mostly scabrous: awns 2-5 mm. long.
1. Culms slender; spikes slender; empty glumes subulate, 1-3-nerved; flowering glumes 6-9 mm. long.
 - a. Spikes very narrow, 5-6 mm. wide or, including the awns, 1 cm. wide; spikelets solitary or in pairs, appressed; awns 1 cm. long or less.....*E. Macounii*.⁴.
 - b. Spikes wider, 9-10 mm. wide or, including the awns, 2-2.5 cm. wide; spikelets in pairs, divergent from the rachis; awns 1.5-3 cm long.
 - (1) Spikelets glabrous.....*E. Arkansanus*.⁵.
 - (2) Spikelets hirsute*E. striatus*.⁶.
 - (a) Spike broader, heavier and with more hirsute empty glumes.....*E. striatus* var. *Ballii*.⁷.
 - (b) Glumes hairy and having a villous sheath.
—*E. striatus* var. *villosus*.⁸.
 2. Culms stout; spikes stout; empty glumes narrowly lanceolate, 3-7-nerved, (or subulate in *E. robustus*); flowering glumes 10-14 mm. long.
 - a. Culm 3-9 dm. high; spike short, dense; flowering glume smooth, scabrous..... *E. brachystachys*.⁹.
 - b. Culms mostly taller; spike longer, often loose and interrupted; flowering glumes mostly hirsute*E. Canadensis*.¹⁰.
 - c. Spike very densely flowered, compact, often included at base; empty glumes narrow, 1-3-nerved, very scabrous; flowering glumes scabrous-hirsute; awn longer....*E. robustus*.¹¹.

1. ELYMUS VIRGINICUS.

Elymus Virginicus L. Sp. Pl. 84. 1753. Watson and Coulter. Gray. Man. Bot. 673. pl. 11. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 126. f. 182. 1894. Beal. Grasses of N. A. 2: 653. 1896. Nash in Britton and Brown. Ill. Fl. 1: 230. f. 534. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 316. f. 612. 1900.

DESCRIPTION.

TERRELL GRASS. An erect, smooth grass, 2 to 3 feet (5-7 dm.) high, with rigid, terminal spikes which are often partly included in the upper leaf sheath. Sheaths striate, smooth or hairy; ligule short; leaf blade 6 to 12 inches (1½-3 dm.) long, 2 to 4 lines (4-8 mm.) wide; acute, scabrous.

Spikes 3 to 5 inches (.6-1 dm.) long, the rachis smooth or scabrous. Spikelets two to three-flowered, smooth; empty glumes lanceolate, thick and rigid, strongly nerved, awn-pointed; flowering glumes lanceolate, rounded on the back, awned. Moist soil, borders of thickets and open woodlands. June to September. See figure 240, on page 339.

DISTRIBUTION.

Iowa. Oskaloosa (White); Muscatine 10 (Ball); Steamboat Rock 3156 (Miss King); Belmond (Clark); Boone (Hitchcock); Jewell Junction (Carver); Sioux City (Wakefield); Chariton 679 (Mallory); Marshalltown (Stewart); Ames (Rolfs, Rich, Crozier, Hitchcock, Bessey, C. A. Wilson, 1094 Wilson, P. H. Rolfs, 125 Ball); Keokuk (P. H. Rolfs); Iowa City (Shimek); Wilsonville (Taylor); Carroll, Boone, 1308 and 1299 Council Bluffs, 902 New Albin, 706 Des Moines, 889 Elmore, Minn., Iowa-Minnesota line, Clinton, 782 Houston County, Minn., Iowa-Minnesota line (Pammel); Emmet County 811 (Pammel and Cratty); Dixon 715 (Snyder); Fayette County (Fink); Wheatland (Ball); Ames 1094 (Wilson); Muscatine 503 (Reppert); Linn County 50 (Shimek); Appanoose County, Decatur County (Fitzpatrick); Farragut (Shimek); Charles City (Sherman); Millford (Shimek); Vinton (Shimek).

North America. Nova Scotia and New Brunswick to Florida, Pennsylvania (Lancaster County, Small), Massachusetts (Sears), Illinois (East St. Louis, Eggert), Wisconsin (Trempleau, Pammel; La Crosse, Miss Pammel), South Dakota (Brown County, Griffith 7), Nebraska (Alma 47, Omaha, Pammel), Colorado (Laramie Hills, Pammel, Johnson, Lummis and Buchanan).

2. ELYMUS VIRGINICUS VAR. SUBMUTICUS.

Elymus Virginicus var. *submuticus* Hook. Fl. Bor. Am. 2: 255. 1840.

DESCRIPTION.

AWNLESS TERRELL GRASS. Spikes erect, 3 to 5 inches (.6-1 dm.) long, with scabrous or smooth rachis. Spikelets two or three-flowered, smooth, empty glumes thick, and rigid, strongly nerved, awnless. Common in moist soil, with the species.

DISTRIBUTION.

Iowa. Marshalltown 785 (Pammel); Ames 124 (Ball); Plymouth County (Brown).

North America. Low land, New England, Minnesota, Colorado to Texas and Wyoming.

3. ELYMUS HIRSUTIGLUMIS.

Elymus hirsutiglumis Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 11: 58. 1898. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 324. f. 620. 1899.



FIG. 241. *Elymus Virginicus* var. *submuticus*—a, spikelet; b, empty glumes; c, flowering glume; d, palea, flowering glume and fruit; e, f, g, rudimentary flower. (Charlotte M. King.)

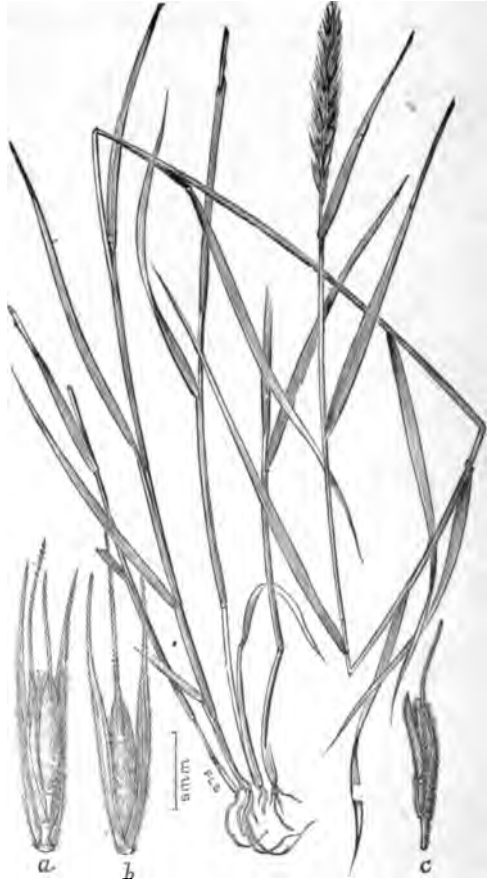


FIG. 242. *Elymus hirsutiglumis*—a, spikelet, b, awned, empty and flowering glume. (Div. of Agros. U. S. Dept. Agrl.)

DESCRIPTION.

HAIRY FLOWERED LYME GRASS. A rather stout, erect, leafy perennial, 2 to 3½ feet (6-9 dm.) high, with smooth culms and sheaths, and erect, slender spikes, 1½ to 4 inches (3-8 cm.) long. Empty and flowering glumes awn-pointed; awns 4 to 8 lines (8-16 mm.) long. July to August.

DISTRIBUTION.

Iowa. Steamboat Rock 3043 (Miss King); Marshalltown (Eckles); Cedar Rapids (Miss Hall); Belmond (Clark).

North America. Maine to Virginia and westward to Illinois and Nebraska.

3. ELYMUS MACOUNII.

Elymus Macounii Vasey. Bull. Torr. Bot. Club. 13: 119. 1886. Beal. Grasses N. A. 2: 653. 1896. Nash in Britton and Brown. Ill. Fl. 1: 231. f. 537. 1896. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 17: 318. f. 614. 1899.

DESCRIPTION.

MACOUN'S LYME GRASS. A slender, upright, smooth, caespitose perennial, 1 to 3 feet (3-8 dm.) high, with narrow erect leaves, and slender, nearly cylindrical spikes, 3 to 5 inches (6-10 cm.) long. Spike-



FIG. 243. *Elymus Macounii*—a, empty glumes; b, flowering glumes and flowers. (Div. Agros. U. S. Dept. Agri.)



FIG. 244. *Elymus Arkansanus*—a, flowering glume; b, empty glume. (Div. Agros. U. S. Dept. Agri.)

lets one to three-flowered, with narrow, lanceolate empty glumes, 4 to 5 lines (8-10 mm.) long. June to August.

Macoun's lyme grass is found in Hamilton County, north to Kosuth County and westward. It occurs in low ground, especially in drains and borders of lakes.

DISTRIBUTION.

Iowa. Rock Rapids 37 (Shimek); Elmore, Minn. (Iowa-Minnesota line) 1043 (Pammel); Rock Rapids 781 (Shimek); Jewell Junction (Carver); Ceylon 3311, Elmore, Minn. (Iowa-Minnesota line) 1923, Spirit Lake 3226 (Pammel).

North America. Iowa to Colorado (Larimer County, Greeley, Ft. Collins, Ogden 35, Pammel), Montana and Oregon (Cusick).

4. ELYMUS ARKANSANUS.

Elymus Arkansanus Scribn. and Ball. Bull. U. S. Dept. Agr. Div. Agros. 24: 45. f. 19. 1900.

DESCRIPTION.

ARKANSAS WILD RYE. A slender, erect perennial, with a short, broad, bristly, nodding spike. Culm 3 to 4 feet (6-8 dm.) high, terete, smooth, nodes smooth, sheaths mostly a little shorter than the internodes, ciliate on the margins or the lower sparsely hirsute-pubescent; ligule less than 1 mm. long, membranaceous; leaf-blades 5 to 10 inches (1-2 dm.) wide, narrowly lanceolate-acuminate, erect or ascending, auriculate at the base, scabrous below and on the margins, finely and densely pubescent above.

Spike long-exserted on the slender pedicel, nodding, 3 to 4½ inches (6-9 cm.) long; internodes of the rachis angular, somewhat compressed, hispid-ciliate on the margins, 1½ to 2 lines (3-4 mm.) long. Spikelets two at each joint, two-flowered, the upper very small; empty glumes divergent, linear-subulate, cylindrical and coriaceous at base, flattened, scabrous and two or three-nerved above, 4 to 5 lines (8-10 mm.) long, or, including the stout, straight, scabrous awn, 1 to 1½ inches (2-3 cm.) long; flowering glume narrowly lanceolate, acute, raised on a short stipe and separating from it by a horizontal constriction, minutely scabrous, three to five-nerved at apex, 3½ inches (7 mm.) long, terminating in a straight, slender, scabrous awn, 1 to 2 inches (2-4 cm.) long. Palea slightly shorter than its glume, rounded or slightly bidentate at apex, hispid on the keels above. June to August. See figure 244, on page 344.

DISTRIBUTION.

Iowa. Logan, Dakota City (Pammel); Nodaway River (Stewart).
North America. Arkansas, Missouri to Iowa.

5. ELYMUS STRIATUS.

Elymus striatus Willd. Sp. Pl. 1: 470. 1797. Watson and Coulter. Gray. Man. Bot. 673. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 127. f. 184. 1894. Beal. Grasses of N. A. 2: 655. 1896. Nash in Britton and Brown. Ill. Fl. 1: 230. f. 533. 1896. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 17: 315. f. 611. 1899.

DESCRIPTION.

● SLENDER LYME GRASS. A slender grass, 2 to 3 feet (5-8 dm.) high, with bristly, nodding spikes. Sheaths hairy, or the upper smooth:



FIG. 245. *Elymus striatus*—a, spikelike. (Div. Agros. U. S. Dept. Agrl.)



FIG. 246. *Elymus striatus* var. *Ballii*—a, empty glumes of lateral flowers; b, flowering glume; c, flake showing rudimentary flower; e, flowering glume of central flower; f, flowering glume. (Charlotte M. King.)

leaves 6 to 8 inches (12-16 cm.) long, pubescent on the upper surface, scabrous on the margins. Spikes 2 to 4 inches (4-8 cm.) long; rachis villous. Spikelets one to three-flowered, pilose hairy; empty glumes awl-shaped, awn-pointed, one to three-nerved, two to three times the length of the florets; flowering glumes 3 lines (6 mm.) long. July to August.

Elymus striatus is common in low woods, in many parts of the state.

DISTRIBUTION.

Iowa. Ft. Dodge (Oleson); Mt. Pleasant 1918 (Mills); Kosuth County 852 (Cratty); Lucas County (Shepperd); Clear Lake 26 (Shimek); Monticello (Bessey); Winterset, Boone, Des Moines, Indianola (Carver); Battle Creek 959 (Preston); Lebanon 23 (Ball and Sample); Clinton (Ball); Sioux City, Cherokee (Wakefield); Ames Crozier; Carver, Ball 166, Fisher, Zmunt, Rich and Gossard, C. A. Wilson, E. R. Wilson, Hitchcock); Council Bluffs, Webster City, 1426 Carroll, 1926 New Albin, Jefferson, 1040 Sioux City, Houston, Iowa-Minnesota line (Pammel).

North America. Maine to Illinois (East St. Louis, Eggert), Wisconsin (Lake Geneva, Ball), South Dakota, Nebraska (Alma, Pammel), Missouri (St. Louis, Eggert; Washington, Pammel), Tennessee, Arkansas, Texas and Wyoming (Devil's Tar, Griffith 540).

6 ELYMUS STRIATUS VAR. BALLII.

Elymus striatus Willd var. *Ballii* Pammel

DESCRIPTION.

BALL'S SLENDER LYME GRASS. Stems erect, slender, single, 2 to 3 feet (5-8 dm.) high, with bristly, heavy spikes. Sheaths hairy or the upper smooth, spikes like the preceding, empty glumes more hirsute than the species. Approaches *E. australis*. July-August. See figure 246, on page 346.

DISTRIBUTION.

Iowa. Muscatine (Reppert); Ames (Hitchcock); Johnson County (Fitzpatrick); Ames (C. A. Wilson); Keokuk (P. H. Rolfs).

North America. Illinois to Missouri and Iowa.

7. ELYMUS STRIATUS VAR. VILLOSUS.

Elymus striatus var. *villosus* Gray. Man. 603. 1848.

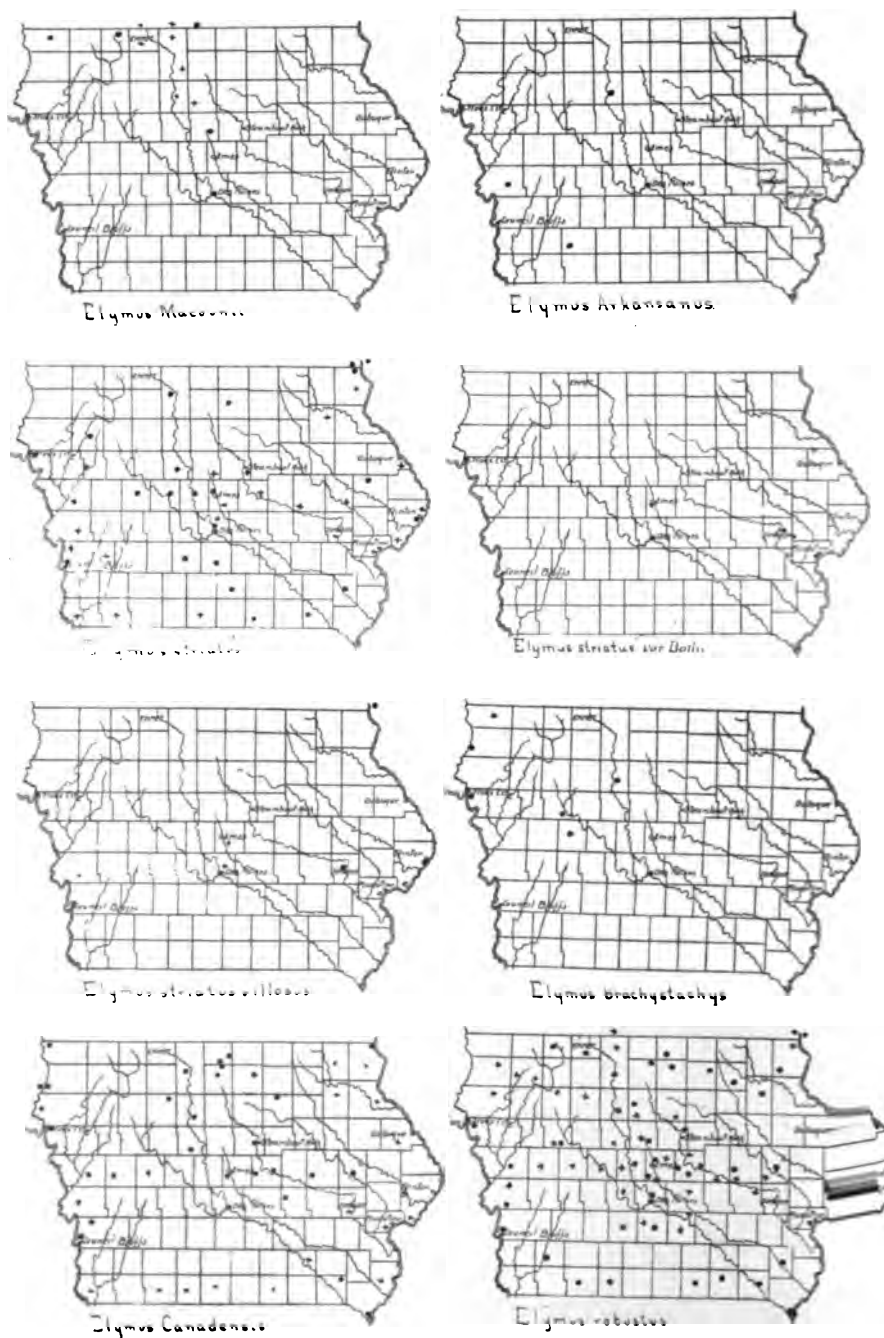


FIG. 247. Distribution of *Elymus*.
 • Specimens in herbarium. + Localities observed.



FIG. 248. *Elymus striatus* var. *villosus*—a, empty glume; b, flowering glume; c, rudimentary flower. (Charlotte M. King.)

FIG. 249. *Elymus brachystachys*—a, spikelet; b, spikelet with empty glumes removed. (Div. Agros. U. S. Dept. Agri.)

DESCRIPTION.

Varies from the type in having the glumes hairy, and having villous sheaths. Culms 2 to 3 feet (5-8 dm.) tall, with nodding spikes, sheaths of leaves villous; empty glumes awl-shaped, or awn-pointed, and hairy. Moist situations in woods. Distributed with the species. July-August.

DISTRIBUTION.

Iowa. Iowa City (Hitchcock); Clinton (Ball); Council Bluffs (Pammel); Steamboat Rock (King).

North America. New York (Parry), with the species.

8. ELYMUS BRACHYSTACHYS.

Elymus brachystachys Scribn. and Ball. Bull. U. S. Dept. Agr. Div. Agros. 24: f. 21. 1900.

DESCRIPTION.

SHORT SPIKED RYE GRASS. A low but rather stout perennial, with bristly, nodding spikes. Culms 1 to 4 feet (3-9 dm.) high, erect or somewhat geniculate at base, smooth, terete; nodes smooth, sheaths mostly shorter than the internodes, smooth, striate; ligule a short, entire ring, less than $\frac{1}{2}$ line (1 mm.) long; leaf-blades 5 to 10 inches (1-2 dm.) long, 3 to $5\frac{1}{2}$ lines (6-11 mm.) wide, acuminate, ascending, semi-involute, smooth or somewhat scabrous below; finely scabrous above and on the margins. Spike rather dense, 4 to $7\frac{1}{2}$ inches (8-15 cm.) long, long-exserted on a stout peduncle; rachis thickened, striate, four-angled or more compressed and two-angled, entirely smooth or scabrous on the angles.

Spikelets glabrous, two at each joint, three to five-flowered; empty glumes flat, scabrous, eight to ten millimeters long or, with the straight scabrous awn, $\frac{3}{4}$ to $1\frac{1}{2}$ inches ($2\frac{1}{2}$ - $3\frac{1}{2}$ cm.) long, $\frac{1}{2}$ inch (1 m.) wide, three or rarely five-nerved; flowering glumes smooth, or minutely scabrous, borne on a short stipe, 11 to 13 mm. long, five-nerved, the nerves next the keel often shortly excurrent, tipped with a straight or sometimes divergent, scabrous awn, 1 to 2 inches (2-4 cm.) in length. Palea about 5 lines (10 mm.) long, narrow, tapering to a narrow, truncate, or minutely bidentate point, scabrous on the keels. July-August. See figure 249, on page 349.

DISTRIBUTION.

Iowa. Carroll, Sioux Rapids, Sioux City, Hawarden, Carnarvon, Dakota City (Pammel), 893 Elmore, Minn., Iowa-Minnesota line (Pammel); Bartlett 934 (Baldwin); Elmore 887 (Pammel); Sioux Falls (Crozier); Rock Rapids 38 (Shimek).

North America. Moist, open or somewhat shaded ground, from Michigan and South Dakota, Nebraska (McCook 362, 217 Alma 45, Hastings 186, Pammel), south to Texas (Nealley), New Mexico, Colorado (eastern part near Nebraska line, Pammel), and to Mexico.

9. ELYMUS CANADENSIS.

Elymus canadensis L. Sp. Pl. 83. 1753. Watson and Coulter. Gray. Man. Bot. 673. 1890. (6 ed.) In part. Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agr. Exp. Sta. 7: 126. f. 183. 1894. In part. Beal. Grasses of N. A. 2: 654. 1896. Nash in Britton and Brown. Ill. Fl. 1: 231. f. 535. 1896. In part.

Elymus glaucifolius Willd. Enum, 1: 131. 1809.

Elymus Canadensis var. *glaucifolius* Torr. Fl. U. S. 1: 137. 1824.



FIG. 250. *Elymus Canadensis*—a, spikelet; b, flowering glume; c, palea. (Charlotte M. King.)



FIG. 251. *Elymus robustus*—a, empty glumes; b, spikelet with empty glumes removed. (Div. Agros. U. S. Dept. Agrl.)

DESCRIPTION.

CANADA LYME GRASS. A rather stout, smooth grass, 3 to 5 feet (7-12 cm.) high, with flat, green or glaucous, scabrous leaves, 6 to 12 inches (1½-3 dm.) long. Sheaths smooth. Spikes 4 to 9 inches (1-2 dm.) long, exserted, nodding; rachis hirsute. Spikelets mostly in pairs, three to five-flowered, with rigid glumes; empty glumes subulate, three to four-nerved at base, awn pointed; flowering glumes rough hairy or nearly smooth, usually long-awned. Loess bluffs. July-August.

DISTRIBUTION.

Iowa. Ft. Dodge (Oleson); Mason City (Pammel); Steamboat Rock 3050 (Miss King); Pilot Mound 3048 (Miss King and MacCorkindale); Wilsonville (Taylor); Wheatland (Ball); Harcourt (Danielson); Keokuk (P. H. Rolfs); Kossuth County 804 (Pammel and Cratty); Hancock County 9 (Shimek); Greene (Miss Price); Hawarden, Cedar Rapids, South Dakota opposite Hawarden, Marshalltown 1079, Dakota City, 901 New Albin, 1280 Council Bluffs (Pammel); Keystone (Koch); Hancock County 6 (near Forest City, Shimek); 707 Forest City, Ames (Carver); Ames 1145 (Louthan, Rich and Gossard, E. R. Wilson, Carver); Grinnell (Jones); Granite, Sioux City (Shimek); Steamboat Rock (Shimek).

North America. On river banks, Nova Scotia to Alberta, south to New York (Washington County, Parry), Wisconsin (Bloomington, C. M. King), Minnesota (Sandy Lake, Sandberg 770), South Dakota (Forest City, Griffith), Georgia, Texas and New Mexico; Colorado (Ft. Collins, Crandall; Colorado Springs and Ft. Collins 265, 344, Pammel; Petersburg, Pammel, Johnson, Buchanan and Lummis), Utah (Duchesne River, Pammel and Stanton, 8500 ft.), Washington (Alma, Elmer, 518).

10. ELYMUS ROBUSTUS.

Elymus robustus Scribn. and Smith. Bull. U. S. Dept. Agr. Div. Agros. 4: 37. 1897. Bull. U. S. Dept. Agr. Div. Agros. 17: 317. *f.* 613. 1899.

DESCRIPTION.

ROBUST LYME GRASS. A stout, leafy perennial, 4 to 8 feet (9-18 dm.) high, with thick, terminal, long-bearded spikes, 5 to 7 inches (10-14 cm.) long. Spikelets three to four-flowered, with linear, subulate empty glumes and scabrous or pubescent flowering glumes. Awns spreading, 1½ to 2 inches (3-4 cm.) long. July to September. See figure 251, on page 351.

Elymus robustus is a segregate from *E. Canadensis*, and is our most common form. Lyme grass occurs along railroads, on the prairie and in the flood plains of our streams. Found in all parts of the state.

DISTRIBUTION.

Iowa. Oskaloosa (White); Ft. Dodge (Oleson); Muscatine 12 (Ball); Pilot Mound 3045 (Miss King and MacCorkindale); Red

Oak 3294 (Miller); Charles City (Pammel); Ames (Crozier, P. H. Rolfs, 117 Ball, Hitchcock, Rolfs, Pammel, Reynolds, Zmunt, Beardslee, 1091 Pammel, 259 Carver); Wall Lake (Hitchcock); Cornell (Smith); Mt. Pleasant 683 (Witte); Keokuk (P. H. Rolfs); Keystone (Koch); Van Cleve (Warden); Mt. Ayr 646 (Beard); Mason City 3134 (Miss King and E. Brown); Boone, Des Moines, Winterset, Indianola, Jewell Junction (Carver); Hamilton County (Rolfs); Hull (Newell); Belknap (Rankin); Harcourt (Danielson); Manly (Williams); Sioux City (Miss Wakefield); Stillwater (Andrews); Missouri Valley, Boone, Marshalltown 1101, 88 (Slater, Des Moines, Clinton, Vernon Center, Minn. (Iowa-Missouri line), Turin, Carnavon, Eagle Grove, Cedar Rapids, Jefferson, Story City, 1302 Council Bluffs, Dakota City, Dubuque (Pammel); Marshalltown (Stewart); Jewell Junction (J. A. Rolfs); Spirit Lake 15 (Shimek); Emmet County 742 (Cratty); Wheatland (Ball); Appanoose County (Fitzpatrick); Fayette County (Fink); Ames 141 (Pammel and Ball); Lawler (P. H. Rolfs); Dixon (Snyder); Taylor County 1110 (Pool); Muscatine 510 (Reppert); Postville (Miss King); Plymouth County, Woodbury County (Brown); High Bridge (Lummis); State Center (Pammel); Algona (Watson); Slater (Fawcett).

North America. Illinois (Chicago, Pammel), Wisconsin (La Crosse, C. M. King, 3119 and 3257), Minnesota (St. Croix, Parry; Vernon Center, Pammel 3), South Dakota (Melleite, Griffith, 139), Nebraska (Broken Bow and North Platte, Pammel), Missouri (St. Louis, Eggert).

7. ASPRELLA.

Asprella Willd. Enum. Hort. Berol. 132. 1809. Endlicher. Gen. Pl. 103. Bentham and Hook. Gen. Pl. 3: 1207. Hackel in Engler and Prantl. Nat. Pflanz. Fam. II. 2: 88. Scribner. Bull. U. S. Dept. Agr. Div. Agros. 20: 168. f. 136.

Spikelets two to three, or sometimes solitary, on each joint of the rachis of a terminal spike, raised on a very short callus; pedicel loosely two to four-flowered (when solitary flatwise on the rachis). Glumes none or small, awn-like and deciduous. Otherwise nearly as in *Elymus*. (Name a diminutive of *asper*, rough or prickly.)

Bentham & Hooker give the number of species as 3, while Hackel gives the number at 4; 2 in North America; 1 in Siberia and 1 in New Zealand.

1. ASPRELLA HYSTRIX.

Asprella Hystrix Willd. Enum. 132. 1809. Watson and Coulter. Gray. Man. Bot. 674. pl. 11. 1890. (6 ed.) Scribner. Grasses of Tenn. Bull. Univ. Tenn. Agrl. Exp. Sta. 7: 127. f. 185. 1894.

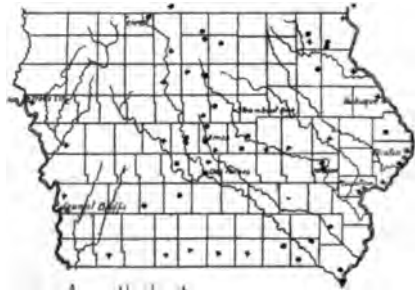
Asprella hystrix (L.) Moench. Beal. Grasses of N. A. 2: 656. f. 125. 1896.

Asprella hystrix (L.) Humb. Scribner. Bull. U. S. Dept. Agrl. Div. Agros. 7: 308. f. 302. 1900. (3 ed.)

Hystrix Hystrix (L.) Millsp. Nash in Britton and Brown. Ill. Fl. 1: 233. f. 541. 1896.



FIG. 252. *Asprella Hystrix*—a, spikelet; b, spikelet without empty glumes at the base. (Div. Agros. U. S. Dept. Agrl.)



Asprella hystrix.

FIG. 252-a. Map showing distribution of *Asprella*.

● Specimens in herbarium.

+ Localities observed.

DESCRIPTION.

BOTTLE BRUSH GRASS. Culms three to four feet high, smooth. Sheaths smooth or minutely scabrous above, ligule very short, its edge shortly and finely fringed, leaf-blade 5 to 10 inches (10-20 cm.) long, 3

to 8 lines (6-16 mm.) wide, more or less scabrous. Spikes 3 to 6 inches (6-12 cm.) long, the rachis much flattened, and ciliate along the edges; the internodes about $\frac{1}{4}$ line (6 mm.) long. Spikelets about one-half an inch long, at first erect, widely spreading in fruit. Empty glumes awn-like, usually present in the lower spikelets, which they sometimes equal in length. Awns of the flowering glumes about 1 inch (24 mm.) long. Straight or sometimes divergent. July-August.

This grass is common in most sections of the state, borders of woods or in woods. The grass is of little agricultural value.

DISTRIBUTION.

Iowa. Pilot Mound 3048 (Miss King and MacCorkindale); Ft. Dodge (Oleson); Steamboat Rock 3148, Postville 3349, Myron 3328 and 3324 (Miss King); Lebanon 24 (Ball and Sample); Mason City 3132 (Miss King and Brown); Nodaway River (Stewart); Dallas Center 819 (Rhinehart); Ames (Hitchcock, Ball 140, Louthan, Chas. Wilson, Sirrine, Beardslee); Emmet County 1053 (Cratty); Ledges, Boone County, Carroll 1425, Mason City (Pammel); Iowa City (Hitchcock, Van Cleve, Warden); Lebanon (Sample); Comanche (Ball); Jackson County, Iowa City (Shimek, Preston Miss Linder), Winneshiek County (Fitzpatrick); Fayette (Fink); Marshalltown (Eckles); Story City (Stewart and Pammel); Mt. Pleasant 862 (Mills); Boone, Winterset, Jewell Junction (Carver); Wilsonville (Taylor); Alden 1129 (Stevens); High Bridge, Dallas County, Hackberry Grove, Keokuk County (Shimek).

North America. New Brunswick to Ontario, New England south to Ohio (Pickerington, Horr), Florida (Curtiss), and west to Texas, and northwest to Illinois, Wisconsin (Parry; La Crosse, D. S. and Edna Pammel; Geneva, Carver; C. R. Ball), Minnesota (Parry), Kansas, Nebraska, Missouri (St. Louis, Eggert), Arkansas.

TRIBE XIII.—BAMBUSEAE.

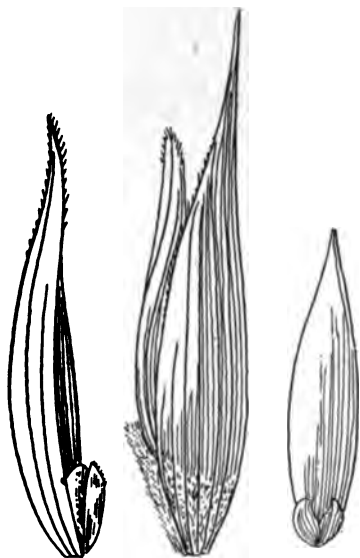


FIG. 253. Parts of a spikelet of *Arundinaria*.

Spikelets 2 to many-flowered (rarely only 1-flowered), in racemes or panicles; empty glumes at the base of the spikelet two to several; flower-glumes many-nerved, awnless, or very rarely short-awned; culms woody, at least near the base, and perennial; leaf-blade usually with a short petiole, and articulated with the sheath from which it finally separates.

A comparatively small tribe of 23 genera and about 200 species. The species are chiefly confined to the region within the tropics. Many of them are of very great importance to the natives of the countries where they grow. Manufactured articles of bamboo, either of use or for ornament, now enter into the commerce of the world. The bamboos are re-

markable for their woody stems and often arborescent or tree-like habit of growth, some of the species attaining the height of 25 to 40 m. In parts of India they form extensive forests. One species in this tribe has leaves 2 to 5 m. long by 10 to 25 cm. wide; another, a Cuban species, has leaves 7 to 15 cm. long, and as fine as a horse hair. Fleshy and edible apple-like or berry-like fruits are borne by some of the species. In the east the bamboos furnish material for the construction of houses, household furniture, and domestic utensils, as well as for articles of ornament, and even clothing. Some supply drink to the thirsty traveler, and the highly farinaceous grain is used by the poorer castes for food. It is recorded that in India the fruit of bamboos have several times been the means of saving hundreds of thousands of people from starvation in times of famine. Many species are now in cultivation and are used for the decoration of parks and lawns. *Arundinaria macrosperma*, which forms the "canebreaks" of the southern states, is our best known example of this tribe. None of the species are native to Iowa.

PHYSIOGRAPHY AND GEOLOGY.

BY

DR. H. F. BAIN.

PHYSIOGRAPHY AND GEOLOGY.

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CHAPTER II. .

PHYSIOGRAPHY AND GEOLOGY.

INTRODUCTION.

In any consideration of the plants of a region a word or two as to the geography and geology of the latter cannot come amiss. Among the various factors which influence the geographical distribution of plants, such matters as altitude, diversity of surface relief, the character of the soils and the conditions of water supply are all of first importance. These are all more or less primarily dependent upon the geological structure of the region. The factor of climate is more remotely related to the same thing. The methods of transportation, the density of population and other industrial factors which are so largely modifying the early distribution of our common plants, also stand in definite relationship to the geology and geography of the region.

It is important to know the geographical and geological features of the region from which any collection of plants has been made, particularly when, as in the case of forage plants, it is desired to estimate the advisability of introducing into other regions any of the plants, or of bringing into the region foreign grasses or forage plants. It is a common observation that certain grasses grow well in particular situations while at neighboring points they sicken and die. While in some cases this is a matter of climate as influenced by a north and south exposure, in a large number of cases the preference which the plant exhibits is for a certain soil. The flora of the driftless and drift-covered regions of Iowa, for example, show the sharpest difference. It seemed best, accordingly, to give a brief description of the physiography and geology of the region from which the plants herein discussed were collected.

PHYSIOGRAPHY.

The Mississippi Valley forms one of the main physiographic features of America. From the gradually decreasing undulations of the Appalachians it stretches unbroken westward to the abrupt foot hills of

the Rocky Mountains, more than a thousand miles away. From the highlands of the Lake Superior region to the low shore of the Gulf of Mexico it is broken only by the dome of the Ozarks and the adjacent ridges of the Ouachita mountains, the cut off and practically buried western extension of the Appalachians. In the northwest the valley is diversified by outlying spurs of the Rocky Mountains, and its floor has been perforated by the isolated group of peaks known as the Black Hills. Around the edges of this great area which the Mississippi has made its own, rise some of the important mountains of America. Out into it they sometimes project, though never far. The territory is not for the mountains and they are either worn away by the rivers or buried beneath the level expanse of softer rocks. In the main the region is one of slight relief. It is open, largely treeless, and shows but little diversity except in minute features. These facts are especially true of the western half to which Iowa belongs. This portion is a vast, open plain cut only by the rivers, and rising with an even, gentle slope from about 500 feet above tide at the Mississippi to 5000 feet along the foot of the Rockies. It is a region of grass land, dotted with clumps of trees along the low banks of gently winding rivers; a region of deep, rich soil; a region where barriers, other than those of climate, are rare, and plants as well as animals have open to them a wide range. In these later days it is a region of fruitful farms, heavy with the staple grains, and of wide pastures of succulent herbage. The abundant grass, the cheap corn, the frequent streams of good water and the nearness to markets make it inevitably a great dairy and cattle country, and the prosperous little cities and thriving villages found throughout the state are but the promise of the denser population of the years to come.

Examined in detail Iowa shows, despite the general sameness, a considerable diversity both in relief and resources. The state occupies the area between the Mississippi and the Missouri, the two great rivers of the region, and extends from latitude $40^{\circ} 30'$ to $43^{\circ} 30'$. It is in the heart of the prairie plain region so aptly described by Powell. It has a gentle surface slant to the southeast from about 1500 A. T. in the neighborhood of Spirit Lake to 477 at Keokuk. The portion of the state southwest of the divide between the two great rivers slopes more gently to the southwest; the divide itself declining gently to the south. The watershed is not ridge-like, but represents rather a broad, elevated table land running from northwest to southeast. The western border of the state is formed by the Big Sioux and the Missouri, and slopes south from 1300 to 900. The Mississippi falls about 165 feet along the eastern border of the state.

No large bodies of water touch the borders of the state and none but small lakes are found within it. The region is one largely fashioned by the action of running water, and the river valleys form, throughout a large portion of it, the natural physiographic features. One other agent has been important, almost as important, in moulding the present surface contours; this agent was ice in the form of vast glaciers or ice sheets. In that portion of geologic time known to the geologist as the Pleistocene or most recent a large portion of North America, including nearly all of Iowa, was buried below the slow moving ice sheets which crept down and over it from the north. Any study of the physiography of the state must be largely concerned with the results of this invasion. From this point of view the state is divided into three separate districts each with certain characteristics common to its whole extent, and each again divisible into smaller areas, if minor differences be taken into account. These areas are (a) the driftless, (b) the region of the older drift, and (c) the region of the younger drifts. The first occupies the extreme northeastern portion of the state, the second lies mainly in the southern portion, and the third includes the remaining area. The approximate limits of these divisions is shown on the accompanying map.

THE DRIFTLESS AREA.

The driftless area includes portions of Allamakee, Winneshiek, Clayton, Dubuque and Jackson counties, with a very considerable portion of southwestern Wisconsin, and smaller parts of Minnesota and Illinois. It is a region of strong characteristics and of marked individuality when compared with the country surrounding it on all sides. It stands in sharp contrast with the drift-covered country. The land forms seen in the driftless area are almost exclusively due to river erosion. The exceptions are certain ridges and sand dunes which have been heaped up by the winds. The Iowa portion of the area lies on the west side of the Mississippi river, and is thoroughly cut up by the numerous tributaries of that stream. The streams have taken full possession of the area. The larger ones have cut to grade and the work of reducing the inter-stream divides is being actively pushed. From the crest of the encircling range of dolomitic cliffs to the sandy flood plain of the Mississippi is an interval of 600 feet. As the distance is rarely more than thirty miles, the streams have high gradients and are busy in the preliminary cutting characteristic of young, torrential streams. Sharp mural walls one hundred to two hundred feet deep are common in the southern portion of the area. To the north, owing to the rise of the strata, the valleys are still deeper. The Oneota or Upper Iowa has cut 350 feet below the immediately adjacent

territory, and more than 600 feet below the highest points in the region. The sharp-walled valleys, narrow, tortuous ravines, the network of streams, and the occasional uninhabited flats are all characteristic of stream action on beds of variable hardness.

The strata of the region are of Paleozoic age, and include hard limestones and dolomites, and soft sandstones and shales. These variations in hardness have resulted in the production of well marked structural plains, the surface rising to the west in a series of steps or benches. In Dubuque county there is an abrupt rise from the Mississippi to the top of the Galena cliffs, about 230 feet. At this level there is an open, rolling plain rising very gently 150 to 175 feet, to the base of the Niagara. This plain marks the horizon of the Maquoketa shales. Above it rise the Niagara cliffs 100 to 200 feet high, and out on it stand the Mounds, isolated



FIG. 254. View near Graf showing the effect of the Maquoketa shales on the topography. The rounded swells and long, cultivated slopes are underlain by shales; the steep, wooded hill in the distance is composed of the overlying Niagara limestone.

patches of Niagara, which are so characteristic a physiographic feature of the region. A view showing the effect of the Maquoketa shales on the topography, near Graf, appears in figure 254.

In Allamakee exactly similar features may be observed, the structural plane here being developed on the easily eroded St. Peter sandstone, and the Oneota and Galena-Trenton limestones forming the lower and upper cliffs respectively.

While the valleys are, as compared with the interstream areas, narrow, they have nevertheless many of the marks of considerable age. As con-

trasted especially with the valley of the Mississippi proper they seem to indicate a long period of undisputed action of the present streams. The lower portions of the streams which come down to join the Mississippi show usually considerable rounding of the cliffs, and quite extensive slopes are developed. Along all but the streams which in time of flood impinge against their banks, talus has accumulated, and long, grassy slopes hide the cliffs. Traveling along the Mississippi north from Dubuque one sees on the other hand a constant succession of high cliffs fronting the river. If he climb these cliffs he will find usually long, grassy slopes leading away from the river, and down to some insignificant stream which has often cut almost to the level of the main valley. This contrast of the two slopes is well shown in Trempealeau mountain, and may be seen at many other points along the stream. The Mississippi is known to have filled in its valley very considerably at some time during the ice period,* and it is now bordered by a well developed gravel terrace, due doubtless to the flooding of the river during the Wisconsin period. The tributaries of the Mississippi have corresponding terraces, containing, however, local material, and due to the ponding of the side streams at the time the larger river was flooded. Manifestly the present Mississippi channel has been recently widened, and the smaller, neighboring valleys show what must have been its character before the larger river was turned into its present course. That the valley has long been the channel of the main stream of the region is evident from the dendritic arrangement of the tributaries, but that this main stream was, previous to the ice period, a relatively small stream there is every reason for belief.

It seems impossible, for the present, to fix definitely the period during which the valleys of the region were cut. The attempt has been made to correlate the plane at the top of the Galena with the Tertiary cycle of erosion, and that touching the tops of mounds with the Cretaceous.† There is, however, but little evidence to sustain this view, and there are a few facts which seem to be against it, so that the matter may well be considered very uncertain.

THE OLDER DRIFT.

Fringing the driftless area on the southwest, but much better displayed in the southern part of the state, is a topography notably different from that just described. It is in the region of the older drift and is well shown in all the area south of a line drawn across the state through Iowa City and Des Moines. In this region rock exposures are relatively few.

*Leverett; Mon. S. Geol. Surv. 87.

†Hershey; Amer. Geol. vol. 20, pp. 243-2-63.

Deep borings and mine shafts show, however, that the rock surface is nearly as deeply trenched by streams as is that of the driftless area. Deep down 400 feet below the high, upland prairies, the drill plunges into the sands and gravels of old river beds. The streams which, before the ice came into the country, flowed in valleys as deep, narrow and tortuous as those of the Oneota, Little Maquoketa or Tete des Morts, are now blotted out. The whole country has been smoothed over, the valleys filled and the uplands cut down. The general effect has been a levelling up. A new upland surface, approximately 100 feet above the old rock hilltops, has been produced. Below this newer upland the present streams have cut to an average depth of about 200 feet. Occasionally these new streams are the lineal descendants of their preglacial prototypes, and run in rock cut valleys whose sides are veneered with drift. The valley sides have, however, gentler slopes and show soft, rounded contours. The upland belts are narrow and, especially in the southwestern part of the



Fig. 255. Loess topography near Iowa City.

state, become narrow divides between streams. The bottom lands are broad and the streams are bordered by alluvial plains. The secondary streams and their numerous branches are regularly and generously developed. Everywhere there is evidence of long-continued action. The surface shows the typical erosion topography such as is developed on soft, homogeneous materials. An example of this is shown in figure 255. Along the Missouri river borders the erosion has been very sharp, and the country is minutely dissected. Here, too, the wind has intervened and has

heaped up the loose loess which forms the surface material, till sharp, conical peaks, precipitous bluffs and choked river valleys abound. This topography is excellently shown in the vicinity of Sioux City and Council Bluffs.

THE YOUNGER DRIFT.

Approximately the northern half of the state is covered by the newer drift. It is in this region that the marks of the ice are most abundant. Across the central portion of this northern area are the marks of a great tongue of ice which crossed the state line with a front stretching from western Worth county to Osceola, and extended down to the present site of Des Moines. This was the last ice sheet which invaded Iowa, and the heaped-up, moranic knobs around the border and within the area covered by it are as fresh and sharp as many moraines of living glaciers. The country is marked by many lakes, and much undrained territory. The hills are rough and irregularly placed, and have no constant relations to the streams. Much of the country is wholly uninvaded by streams, and consists of great, level flats dotted by shallow bogs and small swamps set with water-loving grasses. Everywhere there is evidence of the recentness of the ice invasion.

East of the moraines which border this area from the north state line to Hardin county, and stretching from them to the narrow border of older drift west of the driftless area, is a region which seems not to have been so recently occupied by the ice; the lakes have disappeared, and undrained areas are few. There are no moraines proper, though along much of the border there are peculiar ridges and heaps of loess which are in a measure genetically akin to them. The river valleys are very broad and very shallow. The stream courses are erratic, and the drainage basins unbalanced. The streams occasionally turn aside from a broad, even plain to cut through clusters of high, rocky hills. One frequently ascends from the plain when approaching the river valley, though the stream itself is of course below the level of the plain. The peculiar hills, the strange behavior of the rivers, and many minor factors indicate that it has not been long that the ice has left the country to the fashioning of the rivers, but the amount of work which the latter have done indicates that the period has been appreciably longer than in the north-central part of the state.

In the northwestern portion of the state, west of the moraine and from Sac county to the Minnesota line, is an area which is in many ways to be linked with that just described. There are no corresponding loess ridges, so far as the area has been investigated, and the stream courses are

normal enough as far as direction is concerned. The erosion has not been, however, so vigorous as in the area of older drift, and the stream action seems to have about equalled that in the northeast. In the absence of lakes, but occasional presence of sloughs, the country also resembles the latter. The exact relations of this area to that lying east of it are as yet unknown.

In all this northern portion the drift is even thicker than in the southern half of the state. Rock exposures, except in the northeast, are rare, and bluff slopes, except along the major streams, are unusual. Except in the extreme northeastern part of the state, the area is drift covered, and the smoother, gentler slopes which mark drift covered areas are common.

GEOLOGY.

The physiography of the state afford an accurate index to its geology, especially if the younger or surface formations be considered. So far as plants are concerned it is the geology of these surface formations which is especially important. Over much of the larger portion of the state the underlying rocks crop out at only rare intervals, and while these occasional outcrops afford often the peculiar conditions most favorable to certain individual plants, the major flora of the region must be that supported by the drift and related soils. The underlying strata have but a secondary importance from the present point of view, and will be treated but cursorily.

THE ROCK SERIES.

Sioux Quartzite. The oldest rock in the state is exposed over a few square miles in the northwestern part of Lyon county. It is the Sioux quartzite and consists of a hard, vitreous quartzite, usually thoroughly indurated. It does not yield readily to weathering, except that frost action breaks it into rectangular blocks, and aids in the formation of the river canyons familiar in the region. (See figure 256.) The quartzite contributes but little to the soil, but its influence in a physical way has brought about a distinctive flora.¹ The area of outcrop is small, but the quartzite and certain associated porphyries, granites and schists occasionally found in the deep wells of the region formed probably the earliest portion of Iowa to be exposed. These beds are part of a long tongue stretching southwest from the Archean complex of Minnesota, and are related to the older rocks of central Wisconsin. The

¹Shimek: Proc. Iowa Acad. Sci., 4: 72-77.

later sandstones and limestones of the Paleozoic were laid down in the great basin between these two ancient land masses. As the whole of northwestern Iowa has been buried beneath the Cretaceous beds which were laid down over the upturned and eroded older strata, the beds next in age to the quartzite are found in the extreme northeastern part of the state, where they lie on the flanks of the Wisconsin land. From the northeast to the southwest, successively younger strata are found in parallel and concentric belts, from the Cambrian through the Upper Carboniferous. As pointed out by Norton² these



FIG. 256. Jasper pool in Lyon county. The bluffs are formed of Sioux quartzite.

beds lie with a gentle southward inclination and, in the north, sag toward a line approximately marked by the upper Des Moines river. To the southwest the beds lie approximately level, and, in the southwest and again at Ames, the lower beds rise in a dome which is concealed below the later beds. From Cambrian to Carboniferous the different formations of the Paleozoic occur in regular sequence. The presence of outliers indicates an occasional overlap, and retreating cliff erosion. In the western portion of the state the Cretaceous is found, laid down evidently after a considerable erosion, and resting indiscriminately on all the members of the Carboniferous.

²Iowa. Geol. Surv., 6: 137.

Cambrian. The Cambrian sandstones outcrop along the Mississippi river and its tributaries in Allamakee and Clayton counties, and occur in the valley of the Oneota or Upper Iowa river as far west as Winneshiek county. The maximum thickness of the formation, which is estimated by Norton at about 1,500 feet¹, is nowhere exposed, only the upper part being seen in Iowa. The great bulk of the Cambrian is made up of the Basal sandstone which is covered by the Lawrence shales and limestone, and this in turn by the Jordan sandstone.

Ordovician. Above the latter is the Ordovician or Lower Silurian, which occupies the surface between the Cambrian outcrops and the Niagara escarpment, running from northeastern Howard county to Clinton. The Ordovician here consists of four members with minor sub-divisions, the whole having a maximum thickness, as estimated by Norton, about equal to the Cambrian. The lower member is the Oneota dolomite with its upper and lower divisions separated by the New Richmond sandstone. It is this rock which mainly forms the picturesque cliffs of Allamakee county and which is often known in geological literature as the Lower Magnesian. Above it is the Saint Peter, a sandstone of remarkable purity and uniformity in character and thickness. The Saint Peter is covered by the Galena-Trenton series, really one formation of which the lower portion is undolomitized, and is known as the Trenton, while a varying portion is dolomitized from the top downward and has been named the Galena. The rocks of this formation form the cliffs around Dubuque, and are the source of the lead and zinc ores of the state. Above these cliffs, and stretching by easy slopes up to the base of the Niagara escarpment, are the Maquoketa or Hudson river shales.

Niagara. The Niagara or Silurian, is divisible into several minor formations¹ but for ordinary purposes may be considered as one great dolomitic bed stretching across the northeastern portion of the state. Where not too heavily covered by the drift it yields a very rugged topography. Usually, however, the great drift plain sets in at the outer edge of the formation so that there is little by which to topographically distinguish its area of outcrop.

Devonian. Southwest of the Silurian is the Devonian which is very largely made up of non-dolomitized limestones. In its upper portion it contains an important shale bed, the Lime Creek, noted for its well preserved fossil remains. The Devonian also includes an important breccia which indicates that the conditions were not wholly undisturbed in this middle region in Devonian time. There is in addition an unconformable member as yet known only in Johnson and Muscatine counties, and

¹Iowa Geol. Surv., vol. 6: pl. 6.

²Iowa Geol. Surv., 5: 49-60.

called the State Quarry beds. It is noticeable for the peculiar character of the fish remains found in it.¹

Lower Carboniferous. The Lower Carboniferous or Mississippian is also very largely made up of non-dolomitized limestone, though its lower member, the Kinderhook, includes an important shale bed, some sandstone, and the magnesian limestone and oolite quarried at Marshalltown. The middle and upper members, the Augusta, or Osage of some authors, and St. Louis, include a smaller proportion of sandstone and are almost wholly calcareous.

Upper Carboniferous. The Upper Carboniferous (coal measures) covers approximately the southwestern third of the state, and rests unconformably upon the St. Louis, and occasionally on earlier rock. This division includes two separate formations. The lower, Des Moines series, is largely made up of sandstone and shale and carries most of the productive coal seams. It occupies a strip of country extending approximately from Fort Dodge to Keokuk and from What Cheer to Winterset. Southwest of a sinuous line drawn from southeastern Guthrie county through Madison, Clarke and Wayne to the southeastern corner of Decatur county, the upper division of the coal measures is exposed. This division consists largely of shales and limestone, and carries but little coal. It underlies the Cretaceous for some distance to the north, being found along the Missouri river as far north as Monona County.

Cretaceous. The Cretaceous as found in Iowa includes a basal member, in part conglomeritic and largely arenaceous, running up into shales, and known as the Dakota. Above it is a series of shales and chalk, together belonging to the Colorado, and known separately as the Benton and the Niobrara. In Sioux county there are a few patches of a still later shale belonging to the Pierre. The latter is the youngest formation in the state certainly earlier than the drift. There are some sands in certain of the northwestern counties which may represent a portion of the interval between the close of the Cretaceous and the invasion of the ice, but the exposures are few and the relations are uncertain.

THE DRIFT SERIES.

The general distinctions between the older and younger drifts were noted in describing the physiography. There is, however, a much greater variety in the drift series than this single division indicates. There are in fact evidences of at least four and probably five separate invasions of the state by glaciers. These invasions were separated by interglacial intervals in some cases much longer than the whole of the period since the

¹*Calvin: Iowa Geol. Surv., 7: 72-79.

ice has left the state. During these intervals the state, and at least much of the country to the north, was wholly free from ice and the climate probably did not differ much from that now prevailing.

Pre-Kansan. The earliest ice invasion was the Pre-Kansan. But little is known of it since only scattered patches of the Pre-Kansan drift are found. So far as is known it nowhere outcrops except where the later drift has been eroded. At many points it is absent, presumably having been destroyed or so worked over as to be unrecognizable in the later glacial periods. Between it and the Kansan is the Aftonian interval represented by but few deposits which can be certainly recognized. The length of this interval and the climate prevailing are almost wholly unknown.

Kansan. It is the Kansan drift which covers the greater portion of southern and western Iowa. It consists largely of bowlder clay, usually blue at the base but alternating above first to yellow and then to a deep reddish brown. This change of color and the accompanying phenomena of oxidation, ferrugination, decalcification, etc., are believed to indicate that the drift was long exposed to weathering before the beds resting on it were deposited.

Illinoian. In the extreme southeastern portion of the state there is an area covered by a later drift which in general constitution and character is similar to the Kansan. It is, however, quite distinctly younger and is separated from the Kansan by a well developed soil horizon representing the Yarmouth interval. The drift itself is called the Illinoian and the interval which followed it is known as the Sangamon.

Iowan. Succeeding the Sangamon interval was the Iowan invasion which covered the most of the northeastern portion of our own state and certain parts of Illinois. The Iowan ice behaved in a very peculiar fashion. It seems to have been very thin, particularly along its edge, and stretched out in a series of long tongues, giving a very crenulate margin. The drift itself is very thin but the area covered by the Iowan is characterized by the immense size and number of the surface bowlders. It was apparently during the Iowan period that much of the southern portion of the state became covered by the loess. The latter is a fine silt or clay, usually buff in color rarely showing any signs of stratification, and carrying no pebbles other than lime balls. It spreads out in an irregular sheet forming the surface material throughout the entire state except in the portion covered by the Iowan or Wisconsin ice sheets.

Wisconsin. Later than the Iowan, and separated from it by an interval presumed to be represented by certain fossiliferous beds near Toronto, is the Wisconsin drift. In Iowa we have no representatives of the

Toronto beds and are forced to rely on superposition, the slight topographic difference, and the moraine which generally borders the Wisconsin, to discriminate between it and the Iowan. The general character of the country covered by the Wisconsin has already been noted.

SOILS.

From the foregoing it is evident that the soils of the state are only indirectly related to the underlying rock series. While the bulk of the drift material is derived from the neighboring strata, there is much foreign material incorporated as well. The glaciers gathered up the loose material or ground off the harder rocks over a considerable area to the north and dumped a generous share of this heterogeneous mixture within the borders of Iowa. An examination of a bit of the material shows a great variety in the particles. They are derived from nearly all the varieties of rock. Some are merely ground up and hence are only potential plant food. Others have been oxidized or are otherwise acted upon by the agencies which prepare the rock for the plant. Mixed with this material are bits of wood and vegetal matter which, by developing into humus, aid in enriching the soil.

There do not seem to be many wide and constant differences in drift soils. As a rule they are more sandy than the usual loam. Their chief characteristic is their variability with regard to moisture content. Their heterogeneous texture leads to all conditions from those of drouth to drowning. With careful cultivation, however, this can be very largely controlled. The drift soils prevail throughout the areas of the Wisconsin and the Iowan, though often buried beneath a few inches of fine homogeneous material, probably very largely wind blown.

Much the larger portion of the state has a loess soil. The loess, while composed of the same material as the drift, is very fine and is remarkably homogeneous in texture. This gives it, except in gumbo regions, the valuable characteristic of an even moisture content. It is in almost every instance abundantly supplied with all the elements of plant food, and, with its ability to absorb and retain moisture, it is among the best of soils. Curiously enough in areas of very thick loess it is not so good as where spread out as a thin sheet over the drift. To some extent this seems to be a matter of the topographic development of its surface, but it is not certain but that there are other factors in the case.

A third common soil type in the state is the Alluvium which occurs so commonly along the streams, particularly in the region of the older drift. Since, however, it differs in no way from Alluvium as developed elsewhere it need not be described.

THE ECOLOGICAL DISTRIBUTION

OF

IOWA GRASSES.

BY

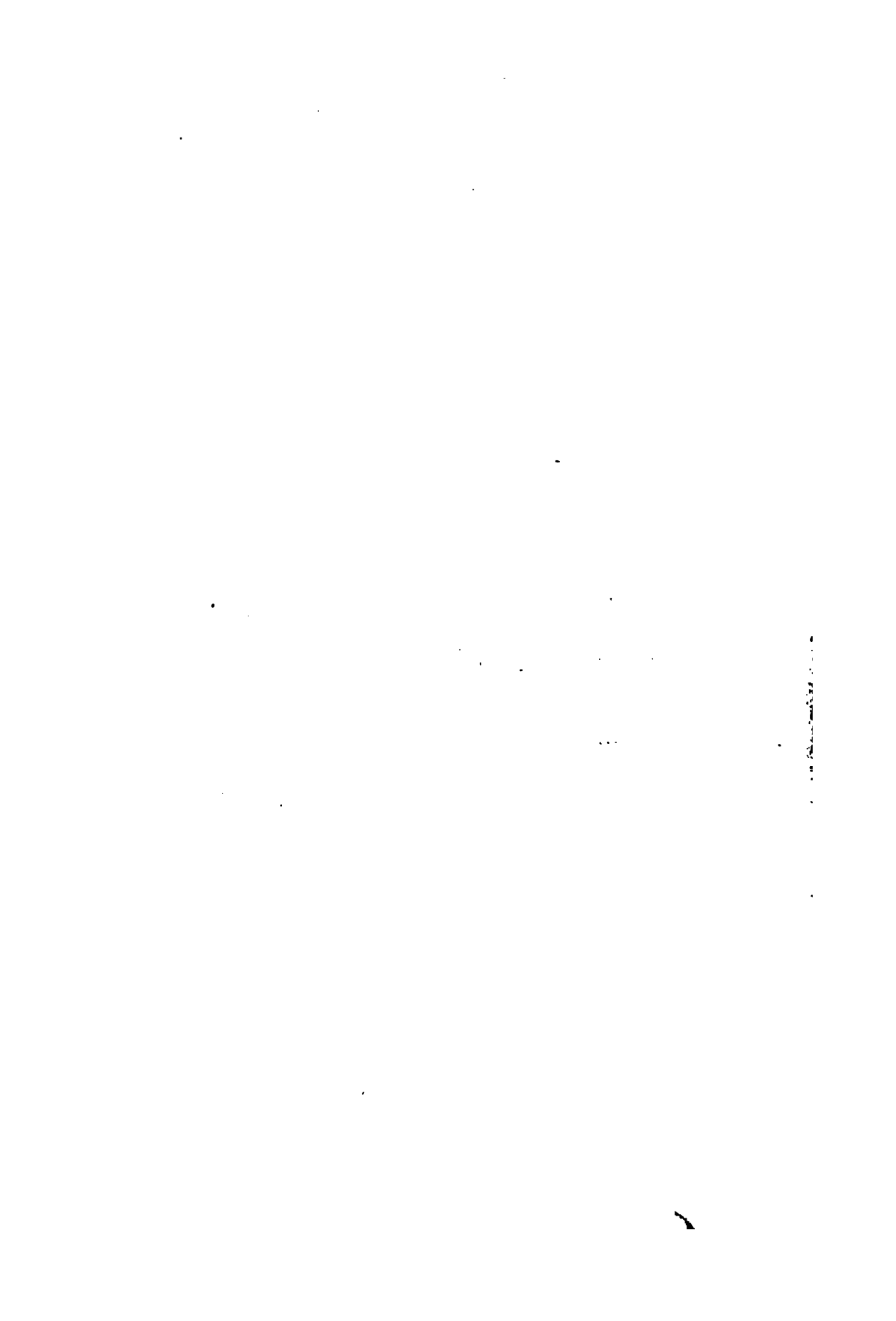
L. H. PAMMEL.

THE ECOLOGICAL DISTRIBUTION OF IOWA GRASSES.

BY L. H. PAMMEL.

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CHAPTER III.

The Ecological Distribution of Iowa Grasses.

GENERAL DISCUSSION.

Plants are dependent on their surroundings. The nature of the soil, such as mechanical and chemical conditions, as well as climate are factors of the greatest importance in the life relations of plants. Naturally in a prairie state like Iowa there is less variation than in a region broken by mountain chains, lakes and bogs. It will not be necessary to treat in



257. Approach to Ledges, Boone county, Iowa. Carboniferous sandstone. *Danthonia spicata*, *Cladonia*, *Ichum* on the bare slopes, *Bromus purgans*, *Festuca tenella* and *Asprella Hystrix* in woods. *Eragrostis* on sandy banks; *E. Purshii* in sandy bottoms. (J. A. Oaughey, Photo.)

detail all of the regions of the state but to call attention to a few of the leading physiographic features and the plants found there. The subject has been discussed briefly by the writer in several papers.



FIG. 258. Forest, Allamakee county, Iowa. *Taxus Canadensis*, *Poa Wolffii*, *Betula papyrifera*, *Abies balsamea* and *Diervilla trifida* (L. H. Pammel, Photo.)

Topographic features exert a marked influence on the distribution of plants, such differences are readily observed in the distribution of grasses, even in a state with a topography so uniform as in Iowa. It will, therefore, be of interest to discuss some of these features. The greater part of Iowa lies between 90° and 96° longitude, being nearly 90° at 32° latitude just north of Clinton and $96^{\circ} 30'$ at the west side, in Plymouth county. The boundary line on the south is somewhat more than $40^{\circ} 30'$, on the north it is $43^{\circ} 30'$. The southeastern county, Lee, exceeds

Some Ecological notes on Iowa Grasses. Proc. Soc. Prom. Agr. Sci. 1898: 204. Contr. Bot. Dept. I. S. C. 12.

Preliminary notes on the Flora of Western Iowa, especially from the Physiographical, Ecological Standpoint. Proc. Ia. Acad. Sci. 9: 152. Contr. Bot. Dept. I. S. C. 21.

this by about one-fourth of a degree. On the 42d parallel of latitude the distance across the state is 380 miles. On the east the state is bounded by the Mississippi, on the west by the Missouri, and in the northwestern part of the state the counties of Lyon, Sioux, Plymouth and a small portion of Sioux, by the Big Sioux. Owing to the general trend of the streams, the northern and southern boundaries are not separated by rivers from the adjoining states, except a small portion of Lee county, where the Des Moines forms the boundary. On the whole, the state is what may be called a typical prairie state, consisting of undulating hills traversed by numerous small streams which during the greater part of the year carry but little water. Toward the Mississippi, especially in the northeastern part, the country is decidedly rough, especially in Clayton, Allamakee and Winneschick counties.



FIG. 250. Marsh in northwestern Iowa, Spirit Lake. *Glyceria nervata*, *Erigeron annuus*, *Juncus*. (L. H. Pammel. Photo.)

DRAINAGE.

About three-fourths of the state is drained toward the Mississippi, receiving its drainage as far back as 95° longitude from the eastern part

of Dickinson, Emmet, Palo Alto, Buena Vista, Sac, Carroll, southeast part of Audubon, Adair, Warren and Appanoose counties. The general trend of the streams is in a southeasterly direction. The counties of Lyon, Osceola, Sioux, O'Brien, Plymouth, Cherokee, Ida, Woodbury, Monona, Crawford, Harrison, Shelby, Pottawattamie, Mills, Cass, Montgomery, Fremont, Page, Taylor, Adams, Union, Ringgold, Decatur and Wayne are drained entirely toward the Missouri, although several streams of considerable size reach the Missouri in that state.

GENERAL TOPOGRAPHY.

General topography exerts a marked influence on vegetation. This is much more pronounced in regions with considerable altitude, since some plants are quite sensitive to slight changes in altitude and other climatic conditions. It is, therefore, important to discuss altitude. Although Iowa is a prairie state, and one in which but slight variation might be expected, there are some strongly contrasted topographic features which have been set forth in papers by Calvin,¹ Keyes,² Beyer,³ Norton,⁴ Tilton and Bain.⁵

ALTITUDE.

The altitude varies throughout the state, but, on the whole it is much more uniform than in many other sections of the United States. It is far less variable than the altitudes of Nebraska and South Dakota. Though the altitude of Dickinson, Emmet, Palo Alto and Carroll counties is greater than those occurring in eastern Iowa, especially northeastern, the country presents a far less broken appearance than the rugged bluffs along the Mississippi in the region about New Albin and McGregor. While altitude is an important factor in the development of plant life, especially in mountainous regions, as in the Rockies and elsewhere, where different species often take on an entirely different character within a few hundred feet, showing marked zonal distribution. Altitude is not so important a factor in the distribution of grasses and other plants in Iowa as might seem at first sight. The general aspect of the

1. Geology of Allamakee county. Ia. Geol. Surv., 4.

2. Geology of Lee county. Ia. Geol. Surv., 3.

3. Geology of Marshall county. Ia. Geol. Surv. 7.

4. Geology of Linn county. Ia. Geol. Surv. 7.

5. Geology of Madison county. Ia. Geol. Surv. 7:494.

grass flora of Dickinson county is not unlike that of Story or Dubuque counties. On the high prairies of the former county *Andropogon scoparius*, *A. provincialis*, *Elymus robustus*, *Panicum Scribnerianum* and *Sporobolus heterolepis* abound. However, the *Sporobolus cuspidatus* and *Elymus Canadensis* are conspicuous features of the gravelly hills, and hills and knolls of Dickinson county.



FIG. 200 Loess bluffs in western Iowa. *Sporobolus cuspidatus*, *Andropogon scoparius*, *Bouteloua racemosa*, *Oxytropis Lambertii* and *Gaura coccinea*. (W. Newell, Photo.)

The altitude of the Missouri river basin is not far from 1000 feet. It is somewhat less on the immediate shore lines of the Missouri, and more than this toward the interior and northward. The following altitudes are taken from the Iowa Geological Survey¹ and Gannett's table of altitudes:

1. Bain, H. F., Geology of Woodbury county, Ia. Geol. Surv. 8: 320.

STATION.	ALTITUDE.	AUTHORITY.
Adel.....	890	C., M. & St. P.
Ames	926	C. & N. W. R. R.
Chatsworth, Big Sioux Valley.....	1,152	C., M. & St. P. Ry.
Carroll, tops of hills.....	1,400	.....
Council Bluffs, Federal building.....	989	.....
Dalton, Floyd Valley..	1,212	S. C. & N. Ry.
Des Moines	799	C., R. I. & P. R. R.
Dubuque	611	C. G. W. R. R.
Keokuk	505	C., B. & Q. R. R.
Merrill, Floyd Valley.....	1,167	I. C. Ry.
Mason City	1,132	C., M. & St. P. Ry.
New Albin	648	C., M. & St. P. Ry.
Salix, Missouri river.....	1,092	S. C. & P. Ry.
Sargent's Bluff, Missouri river	1,103	S. C. & P. Ry.
Sioux City (low water), Missouri river....	1,076	Mo. River Comm.
Sioux City (reservoir), Missouri river....	1,342	City Engineer.
Struble, Floyd Valley	1,271	S. C. & N. Ry.
Westfield, Big Sioux Valley.....	1,131	C., M. & St. P. Ry.

Temperature is influenced to a considerable extent by the condition of the atmosphere. For instance, in 1898, Mr. Sage recorded clear, partly cloudy, and cloudy days for the year as follows:

CLEAR AND CLOUDY DAYS, 1898 AND 1900.	Keokuk.	Sioux City.	Council Bluffs.	Clarinda.
FOR 1898.				
Total clear days.....	152	156	120	189
Total partly cloudy days.....	93	91	129	87
Total cloudy days.....	120	118	95	89
FOR 1900.				
Total clear days.....	242	169	200	164
Total partly cloudy days.....	31	86	74	111
Total cloudy days.....	92	110	91	90

Such grasses as *Bouteloua oligostachya*, *B. racemosa*, *Schedonnardus paniculatus*, *Buchloe dactyloides* and *Sporobolus cuspidatus* are influenced by the drier conditions prevailing in the western and northwestern part

of the state, but it must not be assumed that temperature and moisture are the only features that govern the distribution of these plants. Coming to the eastern part of the state, along the Mississippi, we find such strikingly southern species as *Trioda cupraea*, *T. purpurea*, and *Tripsacum dactyloides*, the latter species occurring in Decatur and Wayne counties; *Panicum filiforme*, *Aristida intermedia* and *Eragrostis trichodes*. Through the northern portion of the state, especially the area affected by the glacial drift, there are a number of typical boreal types such as *Hierochloa bore-*



FIG. 261. Moraine lake, Cerro Gordo county, Iowa. *Hierochloa borealis*, *Calamagrostis confinis*, *Bromus Kalmii* and *Cypripedium*. (Charlotte M. King. Photo.)

alis, *Bromus Kalmii*, *Calamagrostis confinis*, *Poa nemoralis* and *Scolochloa festuacea*.

Mr. Sage and Doctor Chappel of the Weather and Crop Service report the temperature data for various stations in Iowa as follows:

TEMPERATURE DATA.

Mean monthly and annual temperature at various Iowa stations, for the number of years named in the last column.

Stations.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	No. yrs.
Albion	11.6	17.3	28.7	45.3	53.4	66.9	70.9	69.9	59.5	49.1	29.7	17.1	43.8	6
Algona	10.7	17.3	25.5	43.6	50.3	67.7	73.4	70.2	59.9	46.8	31.1	17.8	43.6	11
Amana	13.8	23.5	30.7	48.4	56.6	69.5	73.6	70.3	61.4	50.7	31.8	22.1	45.9	19
Ames	15.3	22.2	32.0	49.2	58.1	69.9	75.0	72.2	63.0	49.7	31.3	23.7	47.2	10
Brookside	12.7	19.9	29.1	45.1	55.0	68.6	73.4	69.9	61.0	46.6	31.4	17.5	44.2	9
Cedar Rapids	16.3	21.5	32.4	48.3	59.0	70.6	74.5	71.6	62.6	49.4	34.5	25.6	47.5	14
Cresco	9.8	15.4	26.0	43.9	55.4	66.1	70.8	68.5	58.9	45.8	29.2	18.4	42.5	19
Clinton	19.1	22.7	32.2	47.8	59.5	69.2	73.4	70.6	62.5	49.3	35.2	25.0	47.0	20
Davenport	20.7	25.4	34.8	50.1	61.0	70.8	75.0	72.7	64.5	52.1	36.8	28.0	49.3	25
Des Moines	17.9	23.6	34.2	50.6	60.6	69.9	74.4	72.1	63.6	52.0	36.9	26.5	48.3	18
Dubuque	18.3	22.8	32.9	49.0	60.4	69.5	74.4	71.7	63.2	50.9	35.1	26.1	48.0	23
Elkader	12.5	18.0	30.6	48.3	60.8	69.5	73.7	70.9	61.6	47.8	31.2	22.2	45.5	14
Fairfield	13.9	21.8	32.8	49.4	59.0	70.0	74.8	70.1	62.9	50.7	35.0	25.6	47.2	9
Ft. Madison	22.4	27.5	37.1	51.2	63.0	73.1	77.6	75.4	65.7	52.7	38.2	26.9	50.8	39
Garnaville	9.0	15.3	26.4	43.4	56.8	65.4	69.1	66.6	56.2	46.1	28.9	16.6	41.8	7
Glenwood	17.4	23.4	33.0	48.8	59.9	70.4	73.5	72.0	61.7	48.9	33.7	25.1	46.5	20
Guttenburg	13.9	20.0	28.7	44.6	57.8	66.7	70.6	67.9	59.5	47.1	31.9	19.3	44.0	17
Ida Grove	19.1	25.0	39.6	57.5	70.2	78.4	81.0	82.3	71.8	62.0	41.6	25.2	54.6	7
Independence	14.7	21.8	29.9	47.2	59.7	69.1	73.4	70.2	61.3	48.2	33.2	21.7	45.7	24
Iowa City	18.9	23.9	33.3	48.1	60.1	68.8	74.1	71.8	63.0	50.3	35.3	27.6	47.6	31
Keokuk	23.6	29.1	37.2	51.9	62.8	72.1	77.1	74.4	66.1	54.1	40.0	29.8	49.0	20
Logan	18.0	24.8	34.3	49.2	61.0	69.5	74.8	72.5	62.7	51.8	35.6	24.5	48.3	23
Monticello	15.2	21.3	31.8	48.3	59.5	68.7	72.9	70.0	61.5	48.7	33.2	22.8	45.9	42
Mt. Vernon	17.1	21.8	31.5	48.7	60.5	70.4	74.1	71.2	62.0	49.1	38.8	28.1	46.4	12
Nashua	8.5	15.4	26.0	41.8	54.9	64.7	70.6	66.3	57.1	43.2	30.6	18.1	41.8	7
Newton	15.4	21.2	31.0	48.4	60.7	70.3	74.7	71.8	61.6	49.6	32.6	22.7	46.6	9
Osage	11.6	16.6	26.5	45.3	56.1	66.4	69.4	66.4	58.6	43.6	26.3	21.1	42.2	6
Omaha	18.8	25.6	35.4	50.6	62.3	71.4	76.3	74.0	63.9	52.7	36.4	25.4	49.4	18
Oskaloosa	16.1	21.5	33.6	49.4	59.3	69.6	75.0	70.9	63.6	50.5	35.9	28.5	47.9	9
Smithland	14.4	17.0	28.5	44.5	63.1	67.9	70.7	70.9	56.8	49.5	26.9	16.4	43.9	4
Washington	16.8	23.7	32.2	50.9	61.1	72.5	77.9	73.6	63.8	51.0	35.4	25.1	49.0	10
Wesley	15.1	22.2	34.4	54.7	60.3	74.7	77.6	75.7	66.4	54.2	35.8	22.8	49.5	8
Means	15.6	21.4	31.7	48.1	60.0	74.0	74.0	71.3	62.2	50.0	33.6	23.0	46.6	..

PRECIPITATION DATA.

Average monthly and annual precipitation (rain and melted snow) at various stations for the period of years named in the last column.

Albion	.91	1.89	2.17	2.04	4.18	5.11	4.54	3.02	4.40	3.07	1.84	1.18	34.45	7
Algona	.92	1.57	1.52	2.20	3.46	4.62	3.04	3.82	3.23	2.21	1.30	.99	27.77	14
Amana	1.42	1.30	1.90	2.72	4.24	4.67	4.18	3.56	3.34	2.84	1.82	1.48	33.61	21
Ames	1.06	.76	1.49	2.77	4.09	4.47	4.72	3.56	3.54	2.24	1.27	1.00	30.44	12
Brookside	1.43	1.67	2.43	2.99	4.82	5.78	5.97	5.29	4.60	3.62	2.24	1.36	40.96	10
Brookville	1.26	1.26	1.99	3.06	3.83	4.97	2.82	3.39	3.00	2.56	1.77	1.62	32.24	11
Cedar Rapids	1.62	1.60	2.37	3.02	4.71	3.84	3.85	2.98	2.87	2.76	1.61	1.75	32.57	31
Cresco	1.38	1.00	1.77	2.16	3.47	5.14	4.32	3.13	3.94	2.36	1.50	1.42	31.45	19
Council Bluffs	.80	1.18	1.37	2.53	4.59	5.95	5.23	3.34	3.45	3.04	1.70	.99	33.36	13
Clinton	1.92	2.32	3.27	3.12	4.47	4.63	4.12	3.63	3.23	2.86	1.96	2.11	37.45	17
Davenport	1.64	1.56	2.11	2.80	4.31	4.30	3.73	3.57	3.21	2.58	2.01	1.31	33.59	25
Denmark	1.46	1.98	2.32	2.53	4.47	5.85	3.33	3.52	2.80	3.32	1.87	1.94	33.56	12
Des Moines	1.40	1.31	1.45	2.66	4.62	5.85	3.19	3.51	3.40	3.53	1.90	1.40	35.06	13
Dubuque	1.64	1.48	2.21	3.06	4.15	5.11	4.43	3.11	4.19	2.70	2.08	1.80	34.56	23
Dysart	1.24	1.24	1.73	2.11	3.89	4.97	4.75	3.80	4.75	3.13	1.79	1.68	34.30	11
Elkader	1.58	1.10	1.74	2.91	3.82	3.94	4.24	2.97	3.00	2.72	1.75	2.32	33.26	15
Fairfield	1.46	1.44	2.01	2.93	6.50	4.17	3.20	3.96	2.85	2.82	2.07	1.80	35.21	9
Ft. Madison	1.90	2.08	2.77	3.13	4.30	4.47	3.90	3.88	3.69	2.98	2.20	1.98	37.58	37
Garnaville	1.03	1.11	1.28	2.00	3.25	3.72	5.27	3.29	4.55	3.21	1.08	1.06	30.85	7
Glenwood	.84	.79	1.39	1.49	5.39	4.69	3.76	3.63	2.20	2.48	1.00	.77	30.80	8
Guttenburg	1.14	1.17	1.88	2.33	3.55	5.17	4.62	3.62	3.87	2.34	2.01	1.89	34.18	10
Ida Grove	.82	1.00	.84	1.64	3.85	5.14	3.71	3.14	3.84	2.70	1.00	.64	28.62	7
Independence	1.37	1.05	1.79	2.21	4.17	5.03	4.72	3.43	4.70	2.37	1.52	1.48	33.87	22

PRECIPITATION TABLE—CONTINUED.

Stations.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	No. yrs.
Iowa City	1.74	1.55	2.58	3.13	4.21	5.03	4.35	4.07	4.24	3.11	2.64	1.74	39.77	23
Keokuk	1.73	1.80	2.16	2.96	4.04	4.92	4.19	3.12	3.53	3.15	2.03	1.96	35.87	20
Le Claire	1.58	1.90	2.21	2.74	4.04	5.22	4.09	3.25	3.26	3.49	1.71	1.75	35.26	8
Logan	1.30	1.36	2.06	2.63	4.46	5.84	5.41	3.82	3.33	2.61	1.31	1.35	35.51	16
McGregor	1.59	1.21	1.90	2.38	3.68	4.96	5.08	3.37	4.04	3.18	1.78	1.79	34.97	16
Monticello	1.57	1.75	2.37	2.62	3.91	4.47	4.20	3.69	3.82	2.77	2.30	2.25	35.79	43
Muscatine	1.31	2.06	2.79	3.41	4.38	4.80	3.91	4.38	3.72	3.04	2.30	2.28	39.22	43
Nashua	1.54	2.23	2.76	2.07	4.19	5.35	6.08	3.87	5.81	3.45	2.34	3.04	45.16	10
Newton .....	.65	.98	1.27	3.37	4.72	4.13	3.50	3.70	3.39	2.60	2.00	1.26	31.57	9
Oange .....	.88	1.04	1.28	2.89	4.40	4.21	3.56	2.81	3.53	2.62	1.59	1.40	30.14	9
Omaha .....	.67	.73	1.46	3.11	4.51	5.64	5.15	3.42	3.36	2.77	1.23	1.01	33.06	16
Oskaloosa .....	.94	1.13	2.16	2.74	3.62	4.42	3.53	2.98	3.27	2.34	1.89	1.28	31.21	11
Sac City	1.29	1.13	1.56	2.91	4.36	5.38	4.11	3.37	3.46	2.28	1.27	1.28	30.83	19
Smithland .....	.54	.65	.66	2.09	3.50	4.32	2.99	2.77	2.84	1.76	1.71	.63	24.43	9
Waterloo	1.18	1.24	1.49	2.00	3.38	3.66	4.05	3.71	4.51	2.27	1.40	1.40	30.76	12
Waukon	1.50	1.39	2.21	2.34	3.57	4.83	4.90	3.43	4.41	2.27	1.77	1.74	35.20	13
Wesley	1.14	1.03	1.42	2.30	3.30	4.74	3.50	2.79	3.52	2.17	1.13	2.16	29.60	10
Means	1.05	1.35	1.88	2.60	4.18	4.59	4.22	3.25	3.44	2.78	1.72	1.31	33.50	...

The regions here considered, naturally, would not show very much variation in temperature except such as is due to latitude. But the north-western portion of the state, because of its higher altitude and open prairies, is somewhat cooler than the more thickly wooded portion of southeastern Iowa. It is an undisputed fact, however, that thermal belts extend along the Missouri and Mississippi rivers. Certain varieties of apples and cherries may be grown along the Missouri that will not succeed further eastward in the same parallel of latitude. Mr. Greene¹, in a paper read before the Iowa State Horticultural Society, has very strikingly brought out these facts in studying fruit bloom. He says, "The maps for April, 1899 and 1900, show the average temperature on the morning of the first day of May. In 1899 there were nine thermal lines presented, 54° to 46°, inclusive, and in 1900, eight, 56° to 49°. The normal temperature for April is 49.5°, so that April, 1900, was 2.7° above the average temperature for that month and ought to be three days earlier. And so it proved to be by the tree record. Last year it was reported from the same place on the 26th, just three days earlier.

In 1899, the isotherm 51° ran through Clinton, Linn, Van Buren, Fremont and Pottawattamie counties, on April 30th. In 1900 it was in Allamakee, Buchanan, Kossuth and Lyon counties. The eastern part was colder, relatively, in the spring of 1900 than in 1899, as compared with the central and western part of the state.

Heat is an important factor in the development of plants. The plant zones of Humboldt were established by connecting the points having the same mean annual temperature. He called these isothermal lines. On this basis there were established the Boreal, Austral and the Tropical

1. Greene, W., Report Ia. State Hort. Soc. 1900: 222.

zones. It was found, however, that zones established on isothermal lines did not express the true conditions, since two points of the same mean annual temperature may show wide differences in the extremes of annual, monthly or daily temperatures. It was found that life processes depend on these more than on the mean, hence some other basis must be established for the life zones.



FIG. 202. Wooded bluffs near Mississippi river. The bare slopes covered with *Andropogon scoparius*, *A. provincialis*, *Bouteloua racemosa*, *Lithospermum canescens*, *Castilleja sessiliflora*. In the woods *Calamagrostis Canadensis*, *Festuca nutans*, *Bromus purgans*. (Charlotte M. King, Photo.)

Merriam establishes his life zones on another principle, namely, that it requires a definite amount of heat to accomplish the life cycle of the plant from the time of germination to maturity. That for a given species this is the same, being the sum of the mean daily temperatures during the cycle of vegetation. This is the physiological constant.

Dr. Merriam recognizes the following classification:

- | | |
|--|-----------------------------|
| (1) Boreal Region..... | { Arctic or arctic alpine. |
| | { Hudsonian zone. |
| | { Canadian zone. |
| Transition zone.... | { Alleghanian |
| | { Arid transition. |
| | { Pacific coast transition. |
| (2) Austral Region. Upper austral zone.... | { Carolinian area. |
| | { Upper Sonoran. |
| Lower austral zone... | { Austroriparian. |
| | { Lower Sonoran. |
| (3) Tropical Region. | |

Alleghanian area. This area reaches its greatest development in this state along the Mississippi and reaches over to the Missouri river, extending farther eastward in southwestern Iowa, thence farther north along the river. The representative plants are:

<i>Juniperus Virginiana</i> (northward).	<i>Tilia Americana.</i>
<i>Quercus macrocarpa.</i>	<i>Sanguinaria Canadensis.</i>
<i>Corylus Americana.</i>	<i>Negundo aceroides.</i>
<i>Rhus glabra.</i>	<i>Ulmus Americana.</i>
<i>Prunus Americana.</i>	<i>Acer saccharinum.</i>
<i>Dicentra cucullaria.</i>	<i>Acer nigrum</i> (Des Moines basin).
<i>Solidago serotina</i> (northward).	<i>Aster Nova-Angliae</i> (northward).

Carolinian. This area reaches its greatest extension in southeastern Iowa, spreading northward to Dakota, with a few representatives. The representative plants are:

<i>Gymnocladus Canadensis.</i>	<i>Juglans nigra.</i>
<i>Morus rubra.</i>	<i>Rhamnus lanceolata.</i>
<i>Nelumbo lutea.</i>	<i>Vernonia noveboracensis.</i>
<i>Polygonum pennsylvanicum.</i>	<i>Polygonum dumetorum</i> var. <i>scandens.</i>
<i>Mariynia proboscidea.</i>	<i>Eupatorium serotinum.</i>

Arid transition. This area reaches its greatest development along the immediate border of the Missouri river, on the loess bluffs, but extends eastward to the divide between the Mississippi and Missouri rivers in Carroll and Dickinson counties. Representative plants are as follows:

<i>Cnicus canescens.</i>	<i>Shepherdia argentea</i> (N.).
<i>Symphoricarpos occidentalis.</i>	<i>Helianthus annuus.</i>
<i>Yucca angustifolia.</i>	<i>Helianthus</i> ^{aximiliani} .
<i>Petalostemon multiflorus.</i>	<i>Gaura coccinea.</i>
<i>Aplopappus spinulosus.</i>	<i>Gaura parviflora.</i>
<i>Grindelia squarrosa.</i>	<i>Liatris punctata.</i>
<i>Euphorbia marginata.</i>	<i>Euphorbia heterophylla.</i>
<i>Hosackia Purshiana.</i>	<i>Lactuca pulchella.</i>
<i>Erysimum asperum.</i>	<i>Dalea laxiflora.</i>
<i>Psoralea esculenta.</i>	<i>Mentzelia ornata.</i>
<i>Lygodesmia juncea.</i>	<i>Sporobolus cuspidatus.</i>
<i>Bouteloua oligostachya.</i>	<i>Buchloe dactyloides</i> (N. W.).
<i>Schedonnardus paniculatus</i> (N. W.).	<i>Oxytropis Lamberti.</i>
<i>Astragalus lotiflorus</i> var. <i>brachypus.</i>	

It should be observed that the zonal boundaries of plants are not sharply marked, but that the different areas contain some types of each of the areas. The main features of the flora are essentially prairie. The intermingling of western and eastern prairie types is most marked on the loess bluffs.

ECOLOGICAL DISTRIBUTION.

Mr. Whitford,¹ who has made a study of the forests of northern Michigan, considers the forests under the subject of climatic, ecological

¹ Life Zones and Crop Zones of the United States. Div. Biol. Surv. U. S. Dept. Agrl. 10. Yearbook U. S. Dept. Agrl. 1897: 115. 1894: 203-214.
1. Bot. Gaz. 31: 291.

and historical conditions. The ecological factors are discussed under the heads of edaphic, atmospheric, hydrodynamic and biotic.



FIG. 268. Porcupine grass the *Stipa spartea*. On grassy knolls, drift soil with *Viola pedata*, *Echinacea purpurea* and *Ceanothus Americanus*.
(Charlotte M. King, Photo.)

1. *The Edaphic.* The soil is an important matter with reference to the formation of plant societies. These conditions are often very local. Some soils readily retain moisture, some absorb heat more than others, and this may determine largely, the presence or absence of plants, as in *Sporobolus cuspidatus* which is so abundant on the loess bluffs and gravelly knolls of western and northwestern Iowa. The amount of humus in the soil is likewise an important matter.

2. Under the term atmospheric are included such factors as forms of heat, light and wind. We have only to notice how difficult it is to establish a forest on the open prairie and how much easier it is to establish a forest in the forested area by proper succession of plant growth. How difficult it is for grasses of the forest to encroach upon the prairie.

3. Hydrodynamic is used here to designate the action of tides and waves upon strand vegetation, and the action of stream and ocean currents in distributing seeds. This has been an important factor in determining the presence of *Spartina* and *Leersia* along our streams.

4. The biotic determine the tension line between forest and prairie. Plant rivalry determines the extermination constantly going on. The forest in our prairie state is constantly extending its area, as conditions suitable for the species are made. In western Wisconsin the hills were usually devoid of tree growth, but since the absence of fire, forest growth has spread to the grassy slopes; the hazel and birch displacing the *Andropogons* and *Boutelouas*; the hazel later being displaced by the white and scarlet oaks.

ECOLOGICAL CLASSIFICATION.

Several different classifications have been proposed for plant societies. The classification of Warming is generally used in this connection. The author has made the following groups: xerophytic, halophytic, mesophytic and hydrophytic.

XEROPHYTIC.

The xerophytic grasses have leaves so constructed that the amount of water transpired is reduced to a minimum. The leaves never open, or roll up during dry weather. As an example, *Festuca tenella* may be given, which grows throughout the state in dry soil. It is specially common in western Nebraska, Colorado, Wyoming and South Dakota regions where xerophytic plants are common. The *Sporobolus cryptandrus* and other western species occur on sandy-gravelly soil, and high prairies subject to drouth. Associated with this species we may mention *Stipa spartea*, and in the western part of this state along the Missouri, *Sporobolus cuspidatus*, *Calamovilfa longifolia*, *Sporobolus longifolius*, *Bouteloua oligostachya* locally, and *Bouteloua racemosa*, more widely distributed. The xerophytic grasses of eastern or central, and southern Iowa usually occur on sandy and gravelly soils, in which there may be an abundance of moisture at times, but as these soils are well drained, and easily give up their water, they become very dry. Here we find such grasses as *Bouteloua hirsuta*, *Aristida basiramea*, *Panicum capillare*, *Cenchrus tribuloides* and *Festuca tenella*; in southeastern Iowa *Triodia cuprea*, *Panicum autumnale*, *Aristida oligantha* and *A. gracilis*. Another most striking peculiarity of xerophytic grasses is that they grow in bunches. A single bunch many contain a hundred or more culms. These bunches are many years old. Some one has suggested that the low places in these bunches are formed for the purpose of providing the plant with water, as the central part is hollow and the surrounding part elevated. There can be no doubt that water collects in this way, but it is only incidentally that plants have utilized this water. This formation is brought about by the

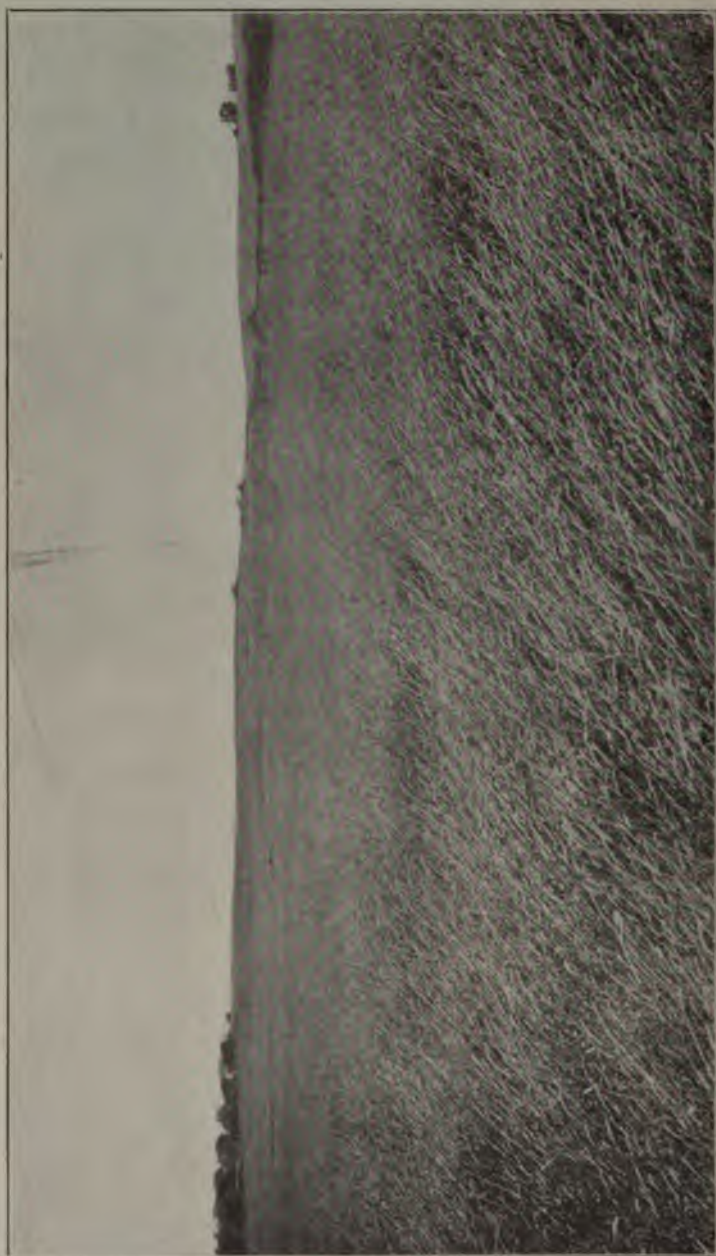


FIG. 394. Field of timothy grass, *Phleum pratense*, Shory county, Iowa. (R. I. Caughey, Photo.)

death of the older and inner parts of the bunch. The border contains living plants, the rootstocks with the adjacent soil are naturally raised. Of the striking bunch grasses belonging to this series we may mention *Calamovilfa longifolia* and *Sporobolus heterolepis*.

HALOPHYTIC.

A close study of the structure of halophytes indicates that these plants are really xerophytic in their nature. Halophytic plants, of course, are such as are adapted to salt marshes and alkaline places, and in respect to their need of water and protection, they behave like the xerophytic plants. Only a single species occurs in the state of Iowa that originally was a strongly alkaline or salt marsh plant, namely the squirrel tail grass. This species no longer confines itself to these alkaline marshes but is found everywhere.



FIG. 265. *Poa pratensis*, Blue Grass in a planted grove. The conditions here are similar to those occurring in pastured woodlands. (Charlotte M. King, Photo).

MESOPHYTIC.

The mesophytic type grades between xerophytic on the one hand and hydrophytic on the other. They are not able to stand the drying influences of a sandy soil so well as halophytic plants, but are adapted to our

forest and prairie conditions. The leaves of these grasses are provided with bulliform cells which cause their rolling up when the soil becomes dry. Several grasses of this class are true bunch grasses, as *Andropogon scoparius* (the bunches often consist of 100 or more culms), *Dactylis glomerata* and *Elymus robustus*. These grasses may be divided into (a) those occurring in forests and woodland, and (b) those occurring in open prairie. The two communities sometimes merge into each other. In most cases the communities are easily separated.



FIG. 266. Wild Rice. *Zizania aquatica*. Found growing with *Sagittaria*, *Phragmites vulgaris* and *Acorus*. Steamboat Rock. (Charlotte M. King, Photo.)

Woodland: *Diarrhena Americana* (widely distributed and associated with *Elymus striatus*, *Festuca nutans*, and *Melica mutica*. The latter though placed here prefers rather rocky, exposed places. Species bordering woods and copses: *Andropogon nutans*, *Elymus Virginicus*, *Asprella hystrix* and *Panicum macrocarpon*.

Prairies: The most conspicuous grass of the prairies is *Elymus robustus*, which grows to great heights, *Andropogon scoparius*, *A. provincialis*, *Muhlenbergia Mexicana*, *Panicum virgatum*, *Sporobolus longifolius*, *S. neglectus*, and *S. vaginaeflorus*.

HYDROPHYTIC.

These grasses are unable to withstand the injurious influences of dry soil and weather. Bulliform cells are rather poorly developed. The grasses grow in water or in moist places, however, some species grade into mesophytic, as *Panicum Crus-galli*, an extremely variable species. We may note here that where these grasses occur, the soil is much colder, and the sea-



FIG. 267. *Andropogon scoparius* and *A. provincialis* with *Solidago rigida*. Ames, Iowa. (Charlotte M. King, Photo.)

son is later than where the soil is well drained. The typical hydrophytes are represented by *Zizania aquatica*, which occurs not only in the bogs of northern Iowa (these very closely resemble the genuine peat bogs of mountains) and those occurring in Wisconsin and Minnesota but also occurs in the bayous of rivers and along the small streams in eastern, central and western Iowa. *Panicularia aquatica*, *P. fluitans*, common in most bogs of central and northern Iowa, and the *Scolochloa festuacea*,

abundant in several of our northern counties, are typical representatives of hydrophytes. *Leersia oryzoides* and *L. lenticularis* are semi-hydrophytic grasses, the first in bogs and along bayous throughout the state, the second along the borders of streams in eastern Iowa, especially the Mississippi river. *Phragmites vulgaris*, a cosmopolitan species, is common in eastern Iowa and in the cold, wet bogs and lakes of the drift area. *Spartina cynosuroides* is less selective than many of the other species; it occurs in little valleys or in sloughs, and is mesophytic rather than hydrophytic, although early in the season it may grow in very moist soil.

**GEOGRAPHICAL DISTRIBUTION
OF GRASSES.**

BY

L. H. PAMMEL.

CHAPTER IV.

Geographical Distribution of Grasses.

Grasses are widely distributed over the earth's surface. Although the species of the order are not so numerous as the Compositae, Leguminosae and Rosaceae, yet in number of plants the grasses outrank every other order. Grasses are an important constituent of the meadows of temperate and colder regions. A meadow has a very different aspect than a plain or desert. In a meadow the grasses form an even turf made up largely of a few species, among which are many of the most important grasses like *Poa* and *Glyceria*. On the dry plains, savannas and steppes, *Stipa*, *Festuca* and *Andropogon* predominate. Here the grasses grow in bunches forming scattered tufts. Here the question is largely one of obtaining moisture. Look where you will over the earth's surface, and grasses occur. They are present in icy Greenland and in the Arctic and Antarctic regions; they are found at the very edge of the snowcovered mountains of the Rockies, the Andes, the Himalayas; they are abundant in the tropical jungle, where they form impenetrable masses, like the bamboos which are so common in China, Java, Sumatra and India, forming a part of the tropical forest in the region of the Monsoon. Species of grasses are much more abundant in the tropics than in temperate or colder regions. The greensward is typical only in a country where the ground is covered with a mantle of snow for a part of the year.

The distribution of grasses may best be seen from an analysis of some of the genera. The genus *Poa*, of which there are about one hundred species, is found mostly in the northern temperate and Arctic regions, but a few of the species are also found in colder, temperate regions of the Southern Hemisphere; a few even occurring in the high mountains of the tropics. The *Poa pratensis* is found in Europe and North America. The *Poa alpina* in the arctic regions of America and Europe, and the high mountains of New England and the Rockies. The *Poa flabellata*, the largest grass of the genus, occurs in the Falkland and Fire Islands. The *Scolochloa festuacea*, allied to *Poa*, is found from Emmet and Kossuth counties through Minnesota, Dakotas, to Lake of the Woods and Saskatchewan to the Peace River country, and in northern Europe and Asia.

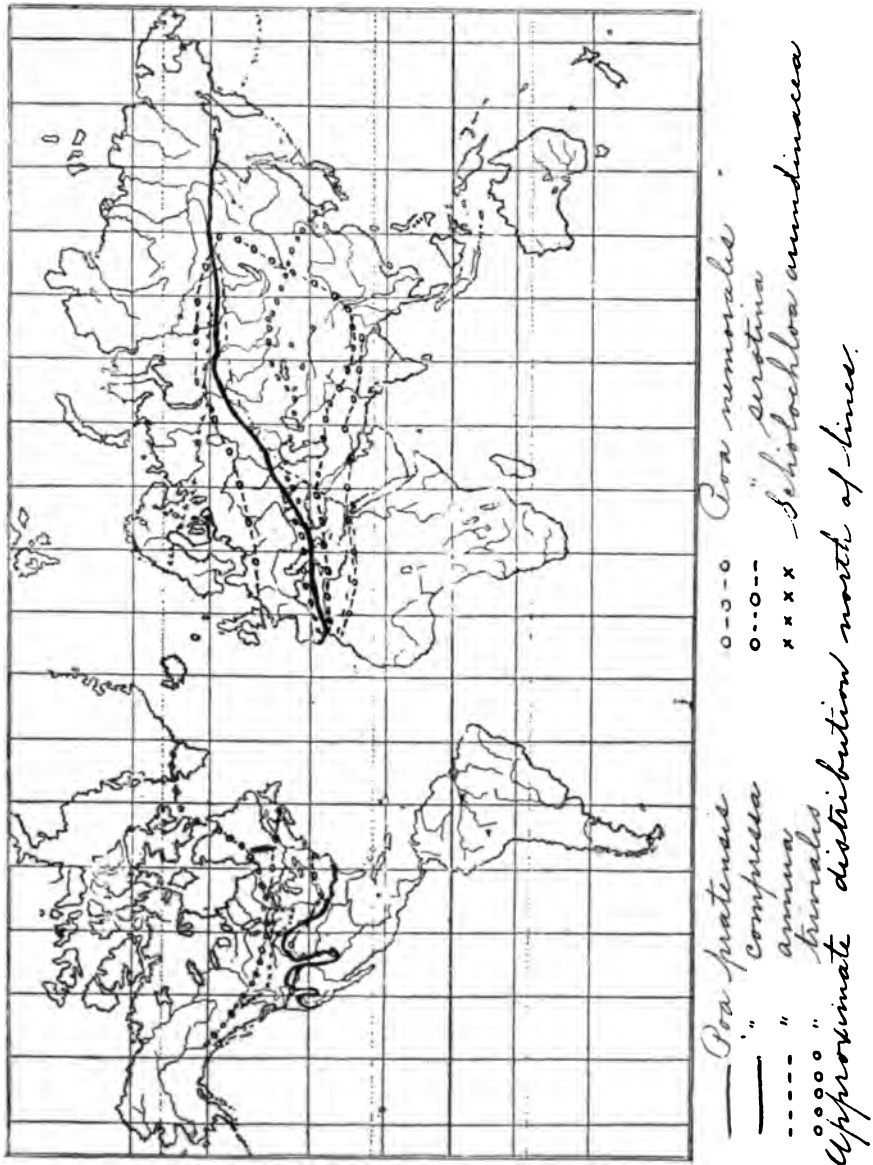


FIG. 268. Map showing general distribution of *Poa* and *Scolochloa*.

The *Glyceria grandis*, another ally to the foregoing, is common throughout the northern states to Colorado, California, British Columbia and Sitka, Alaska. An allied species, *G. fluitans* is cosmopolitan, occurring in Europe, Asia, Africa and Australia. It is common throughout northern United States, south to Arkansas and Tennessee. The genus *Bromus* is cosmopolitan, common especially in the Northern Hemisphere, a few occurring in the tropics, well represented in the Rocky Mountains and Europe. The *Bromus inermis* of Hungary and Switzerland has a near relative in the northern Rockies, the *Bromus Pumpellianus*. The *Bromus secalinus*, *B. arvensis* and *B. tectorum* are cosmopolitan weeds.

The genus *Hordeum* occurs in Asia, Europe, North Africa, North and South America. The *H. nodosum* found in northeastern Iowa is widely distributed in the United States from Ohio to Minnesota and Texas; common in the Rocky Mountain region to Nevada, California and Vancouver. The *Hordeum jubatum* along the Arctic coast, the Great lakes and westward to the plains and the Rocky Mountain region, Utah, Nevada, to Vancouver, Saskatchewan, Peace River, also in southern Russia and eastern Siberia.

The genus *Elymus* generally in temperate regions except Australia and South Africa. Three species, *Elymus striatus*, *E. Canadensis*, and *E. Virginicus* are common on the Atlantic coast and in the Mississippi Valley. The *E. condensatus* is a Rocky Mountain species abundant in the flood plains of streams. Sitanion, which is closely allied to *Elymus*, is a development of the North American plain, perhaps reaching southwestern Minnesota. The numerous species made of this genus will scarcely hold. Another ally of *Elymus* is *Asprella* with four species; North America two, Siberia one, New Zealand one. The *Asprella Hystrix* is of wide distribution in eastern North America, while *A. Californica* has a somewhat limited range on the Pacific coast.

The genus *Agropyron*, generally distributed in temperate regions, is conspicuous on the plains and in the Rocky Mountain region.

The *A. occidentale* and *A. caninum* in northern United States and Canada, the latter also in Europe, Asia (Siberia and Himalayas). *A. glaucum*, a maritime species of Europe, Asia and eastern United States. The *A. repens* a common weed in Europe and northern United States.

Of the large number of species of *Festuca* described, one hundred and twenty-nine are credited to Europe by Richter, however, Hackel gives only eighty species, found chiefly in temperate regions. The *Festuca ovina* and *F. rubra* are cosmopolitan, common only in northern portions of the United States and in the Rocky Mountains; southward these species have become naturalized. The *Festuca octoflora* common



■ <i>Scholochloa festuacea</i>	<i>G. Hallii</i>	—
⌘ <i>Cynodon dactylis</i>	<i>Poa pratensis</i>	+
c <i>Chloris verticillata</i>	<i>Stipa spartea</i>	●
* <i>Bouteloua oligostachya</i>	<i>S. comata</i>	□
o <i>Andropogon provincialis</i>	<i>S. avenacea</i>	s

FIG. 269. Map showing general distribution of grass species.

throughout North America on the plains and in sandy soil. The *F. nutans* is a woodland species of eastern North America and the Mississippi Valley, while the *F. Shortii* is somewhat more limited in its distribution, found in low swales and meadows.

Schedonnardus paniculatus and *Buchloe dactyloides* are essentially species of the plains east of the Rocky Mountain region. The former extends from New Mexico and Texas to Assiniboia, reaching northeastern Iowa and southeastern Minnesota and Arkansas; the latter has a somewhat similar range though extending to Mexico and Arizona. The *Bouteloua oligostachya* ranges with the Buchloe, excepting that it ranges westward to southern California and east to Wisconsin. The *Bouteloua hirsuta* extends to Mexico and east to the Mississippi Valley. The *B. curtipendula* extends from Mexico nearly to the Atlantic coast. The *Phragmites vulgaris* is cosmopolitan; common in Europe and Asia; also found in Australia, common in Iowa and the northern Mississippi Valley to Kansas and Mexico. The genus *Eragrostis* is cosmopolitan, chiefly tropical. The *E. major*, a common, introduced weed, occurs in Europe and Africa. The *E. reptans* is common in the Mississippi Valley extending eastward to New England, also in Trinidad and Buenos Ayres.

The genus *Sporobolus* is tropical. The species found in Iowa are common southward. The *S. heterolepis* reaches its best development on the prairies from Minnesota to Texas. The genus *Muhlenbergia* attains its greatest development in the southwest, extending to the Andes of South America. Some species also occurring in Asia (Japan and the Himalayas). The *M. diffusa*, *M. tenuiflora*, *M. Mexicana*, and *M. racemosa* are common in the Mississippi Valley to the Atlantic coast.

The *Stipas* are largely developed on the plains and steppes. Our most common species, the *S. spartea* is common in the northern Mississippi Valley east to Michigan, Canada, Missouri to Colorado and the Dakotas. The maximum development is attained from Minnesota west to Wisconsin and Nebraska. The *S. comata* is western, but has made its way into Iowa along the Missouri, its range is much wider than the preceding. The *S. viridula* is an introduced species abundant from New Mexico to British America. The genus *Leersia* is represented in the state of Iowa by three species. Two of these, *L. oryzoides* and *L. Virginica* are common throughout eastern North America. The *L. lenticularis*, a sub-tropical species, reaches as far north as Lansing on the Mississippi river, and to Virginia on the Atlantic coast. The *L. oryzoides* has been widely naturalized in the old world, especially in southern Europe, temperate Asia, and north Africa. It is, however, an American species.

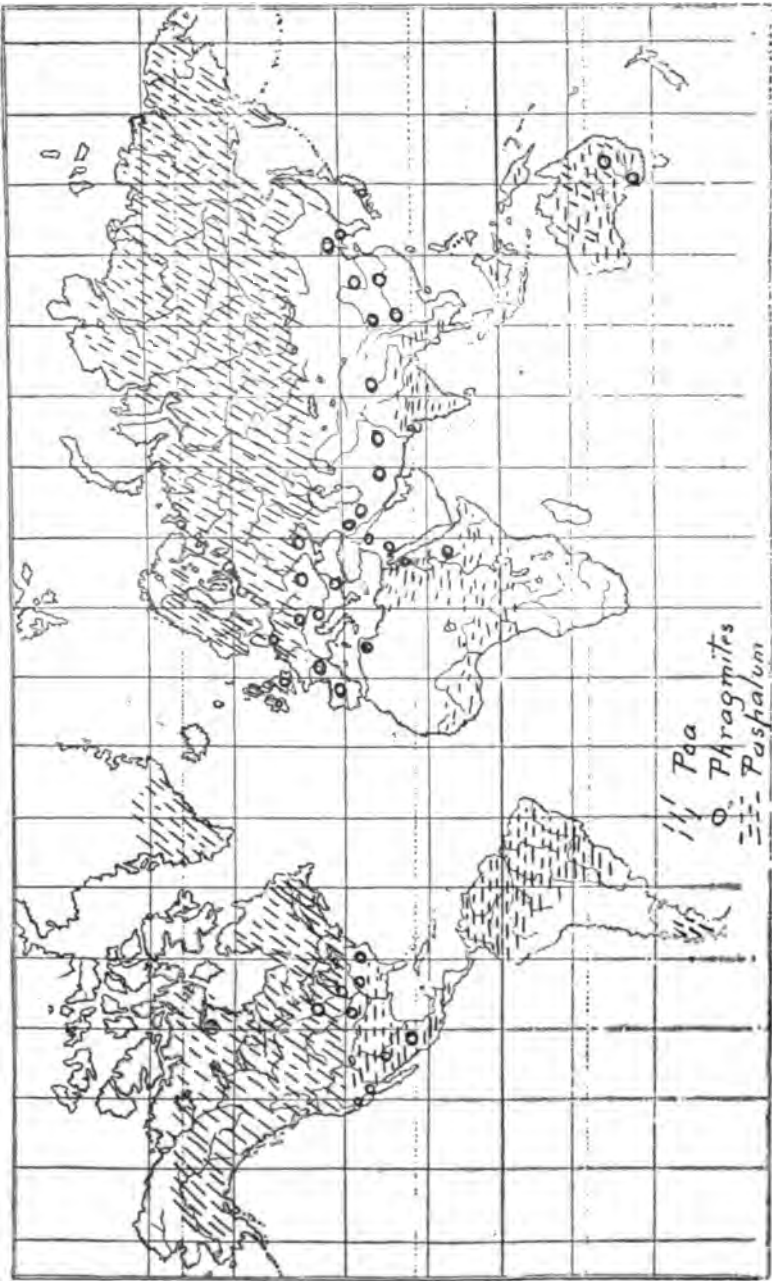


FIG. 270. Map showing general distribution of *Poa*, *Phragmites* and *Paspalum*.

The *Zizania aquatica* is common in British America, northern Mississippi Valley, along the Atlantic coast from Newfoundland to Pennsylvania and Florida, Arkansas, eastern Texas to Missouri and central Nebraska. It is also found in central Siberia and Japan. The genus *Zizaniopsis*, with one species and two varieties, occurs from southern United States to Brazil.

The large genus of *Paspalum*, with one hundred and sixty species, is poorly represented in northern United States; Iowa having a single species and a doubtful second, the *P. mucronatum*. In southern United States the genus is a large and important one. The genus *Panicum* in number of species outranks the former. Three hundred are recognized. It is generally found in warm countries with a few in the temperate regions. The genus is conspicuous in the savannas of South America. *Panicum* is the largest genus of grasses in Iowa. The genus *Andropogon* occurs in warmer regions of North America, Asia and temperate Europe. The latter with eight or nine species. Fifty species of the *Arthrolophus* (subgenus) like *A. provincialis* are largely American. The subgenus *Sorghum*, belongs to the torrid and warm temperate countries (Africa, etc.). Hackel in concluding his paragraph on the distribution of grasses says:

"Not less than 90 genera are common to both continents; among these are many that are exclusively tropical, and besides ten single types. No one tribe is confined to one hemisphere, and no genus of numerous species to any one floral region. All this goes to prove that grasses are a family distributed very uniformly, and that the separation of their tribes goes back to very ancient times. To be sure, the single tribes have varied under the influence of the later divisions into zones; while the *Paniceae* and *Andropogoneae* preponderate in the tropics, they are put in the background by the *Festuceae* *Aveneae*, and *Hordeae* in the temperate and frigid zones. The eastern North American forest region has preserved many more of them (and in general of tropic types) than has the Old World."

Dr. W. J. Beal in an admirable article summarizes the distribution of grasses as follows:

"North America, as would be expected from its extent and configuration, has a greater number and variety of grasses than Europe, and Europe a greater number and variety than Australia. Europe lacks many of the species found in tropical and subtropical North America and Australia. North America compares favorably with Europe and Australia combined. In the north of North America are species of European genera; in the south, species of many of the Australian genera."

Partial Bibliography Pertaining to Grasses

by

Harriette S. Kellogg and L. H. Pammel.

CHAPTER V.

Partial Bibliography Pertaining to Grasses.

The following are some of the more important works dealing with the subject of grasses.

As a matter of convenience to the student of grasses, there is appended to the descriptive part of this volume a list of some of the more important works on grasses, as well as papers dealing with the flora of Iowa and the adjoining states. In making up the distribution of grasses some of these papers have been consulted. I have not relied on them except where I felt confident that the species occurred. For the Mexican distribution, I have made use in many cases of the statements in *Biologia Centrali Americani*, as references to these species of Mexico and Central America are based on specimens found in the Kew Gardens. I have in a similar way made use of Watson and Brewer's *Botany of California*, Macoun's *Catalogue of Canadian Plants*, Macmillan's *Metaspermae of the Minnesota Valley*, Coulter's *Flora of Texas*, Mohr's *Flora of Alabama*, the distribution given by Watson and Coulter in *Gray's Manual* and Britton's *Manual*, but above all I have used the distribution given in the various publications of the Division of Agrostology, United States Department of Agriculture. Owing to the many changes that have been made in the names of species, it was, of course, impossible in most cases to make use of the many excellent catalogues.

The following abbreviations referring to the character of the literature have been used: Ec. (Economic), Fl. (Floras), Hist. (Historical), Morph. (Morphological), Ph. (Physiological), Syst. (Systematic).

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BY R. E. BUCHANAN AND ESTELLE D. FOGEL.

EXPLANATION.

Synonyms are in *Italics*.

Tribes are in SMALL CAPITALS.

Genera are in **Bold Faced Type**.

The number of the figure is in *Italics*.

The page of the map showing distribution is preceded by m.

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...the study of the nature, structure, functions, uses and management of information, and the study of the nature, structure, functions, uses and management of communication. (p. 1)

The 'communication' field is defined as:

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The 'information science' field is defined as:

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